MOTIVATIONS AND DRIVERS OF TRAPPER CATCH PER UNIT EFFORT IN ALASKA

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MOTIVATIONS AND DRIVERS OF TRAPPER CATCH PER UNIT EFFORT IN ALASKA

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Abstract

Indices of abundance based on harvest alone have long been used to track furbearer populations. However, abundance indices based on harvest alone do not account for variation in trapping effort. To my knowledge, adjusting harvest-based furbearer abundance indices to account for effort has not been previously examined in Alaska. Understanding how effort varies among trappers, and how social issues and external factors such as human conflict and fur prices affect effort, can give a clearer understanding of why trapping effort changes. A trapper's motivations may determine how strongly various external factors and social issues influence trapping effort. I sent a questionnaire to trappers of interior Alaska and used nine years of statewide data from the Alaska Trapper Questionnaire (distributed annually by the Alaska Department of Fish and Game) to address these issues. Across five regions from 2004-2013, I found that total fur harvest increased with per-capita trapper effort ($R^2 = 0.125$, $p = 0.02$). Variation in average winter temperature across game management regions explained 42% of variation in trapping effort, but annual variation in temperature, snow depth, fur prices, and fuel prices did not affect effort. Corresponding to these statewide findings, surveys of trappers in interior Alaska indicated that economic gain was not a strong motivation to trap, a finding that differs from previous studies. The most important social issues and external factors affecting trapping effort were access to land and the perceived abundance of furbearer populations respectively. To determine the motivations of interior Alaskan trappers, I used a k-means cluster analysis that identified four groups of trappers: management (17% of trappers), recreational (39%), subsistence (18%), and solitary (26%). Each group is represented by its strongest motivation for trapping. To improve the use of harvest as an index of furbearer abundance, I recommend accounting for trapping effort by calculating catch-per-unit-effort (CPUE), a metric

commonly used in fisheries. I further recommend that resource managers should focus their efforts on reducing human conflicts while maximizing the non-monetary benefits of trapping. Resource managers should take advantage of questionnaires to help understand the fluctuations in furbearer populations and understand the motivations of trappers.

Dedication

This thesis is dedicated my mother Leslie Dorendorf, for inspiring me to learn more about the natural world, and all the amazing plant life it holds, which led me down the path that I am on now. Also, my father, Michael Dorendorf for teaching me patience, attention to detail, and doing kind things for others with no expectation of reward. I also thank him for my inherited passion for the Chevrolet Corvette (especially the 1964 Stingray with a 327 cid. V8). My parents' love, support, and inspiration enables me to pursue my dreams. I would also like to dedicate this thesis to Madison McConnell for her love, encouragement, and limitless passion for life.

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Introduction

History of fur harvest

The fur trade was critical to the development of the North American economy during the early 1600s to late 1800s (Dolin, 2010). Trade between Europeans and Russians with Native Americans and Alaska Natives provided the majority of furs to early settlers (Dolin, 2010; Naske & Slotnick, 1994; Ray, 1998). Furbearers provided food, clothing, and income to early trappers, which made it possible to push into unexplored territories. Many fur trade posts turned into permanent establishments and later cities that helped connect the eastern United States to the western United States (Gowans, 2009; Hafen, 1995).

As in the contiguous United States, the fur trade influenced early economies in Alaska (Andersen, 1993). Initially furs provided means of survival to Natives in the Arctic. Native Athabaskans' affinity for furbearers made trapping an important source of clothing and food (Osgood, 1940). When outside fur companies such as the Russian—American Company and the Hudson Bay Company established in Alaska in the 1800s, fur trapping expanded with the help of Alaska Natives (Naske & Slotnick, 1994). Businesses traded with natives for furs, which fueled the Russian, British, and American economies. In 1899 the U.S. Congress amended the Customs Act allowing non-natives to trap in Alaska (M. Webb, 1985). In its early days, the fur trade caused major declines in species such as beavers (*Castor canadensis*; Hill, 1976). Trapping also aided in the widespread decline of predators in the United States through government supported eradication campaigns by hunting, trapping, and poisoning predators until the 1970s when programs were reformed (deCalesta, 1976). More recently, however, trappers have aided conservation efforts by helping biologists re-establish populations of once extirpated wolves (*Canis lupus*) to Yellowstone National Park and river otters (*Lontra canadensis*) to Pennsylvania

(Serfass, Peper, Whary, & Brooks, 1993; S. M. Webb, Davidson, & Boyce, 2008)

Trapping effort

Currently, fur trappers play a key role in the management of furbearer populations by providing vital data on the abundance of species they catch (Armstrong & Rossi, 2000; Hiller, 2011; Todd & Boggess, 1987; S. M. Webb, 2009). Managers traditionally used harvest numbers as an index of abundance (e.g. Banci & Proulx, 1999; Brodie & Post, 2010; Royama, 1992; S. M. Webb, 2009). However, harvest records alone may be inaccurate measures of abundance (Smith, Brisbin, & White, 1984; Winterhalder, 1980) because other factors such as number of trappers, trapping regulations, reporting accuracy, and trapper effort influence harvest levels and may obscure trends in furbearer abundance. Tracking trapper effort can improve abundance indices, allowing better predictions and monitoring of furbearer populations (Chilelli, Griffith, & Harrison, 1996; DeVink, Berezanski, & Imrie, 2011; Poole & Mowat, 2001; Wilson, Cole, Nichols, Rudran, & Foster, 1996).

Fisheries researchers found that adjusting harvest with measures of effort increased accuracy of abundance indices (Baranov, 1918; Gulland, 1964). For decades, fisheries researchers and managers have used catch per unit effort (CPUE) as an index of abundance (e.g. Harley, Myers, & Dunn, 2001; Maunder et al., 2006; Rose & Kulka, 1999). However, the accuracy of CPUE has long been questioned (Beverton & Holt, 1957) because simple CPUE metrics fail to account for factors such as skill of the fisherman, catchability, or method of harvest (Harley et al., 2001). These factors may account for variability between effort and catch. Understanding key factors affecting effort may allow managers to develop improved indices of abundance for harvested species. Should effort be accounted for when using furbearer harvest as an index of abundance? If so, what factors affect trapping effort? These questions have not been

previously examined in Alaska, where fur harvest remains an important cultural, management, and recreational activity.

Social science theory and background

Satisfactions sought by consumptive users of wildlife vary depending on the motivations for participation, which inevitably influences effort. Originally, game management relied on two major satisfactions of hunters, "bagged game", and later "days afield" (Hendee, 1974). These two measures defined the success of hunting management until the realization that hunters derive multiple satisfactions from hunting. Hendee and Potter (1971) explored the multiple satisfactions of hunting by asking hunters their reasons for hunting. Hendee (1974) later applied this theory to all game management as a more robust measure of the satisfactions that hunters attain from their sport. Hendee's findings led others to apply the theory to game management of many species (e.g. Decker, Brown, & Gutierrez, 1980; Manfredo, Fix, Teel, Smeltzer, & Kahn, 2004; McCullough & Carmen, 1982).

Satisfactions are the desired end result of initial motivations for trapping. These motivations may dictate how and if people trap. Many motivations may exist for trapping, including nature appreciation, escape and relaxation, personal achievement, wildlife use and management, affiliation with others, cultural ties, and economics (Gese, 2001; Kellert, 1981; Muth, Daigle, Zwick, & Giass, 1996; Siemer, Batcheller, Glass, & Brown, 1994; Todd, 1987; Todd & Boggess, 1987). Thus far, only one study in Alaska has explored motivations of trappers (Bailey, 1981), intensifying the need for new information. Bailey (1981) found the most important motivation for trapping on the Kenai Peninsula was an outdoor experience. Exactly how these potential motivations influence trapping effort today is unknown in Alaska.

External factors

External factors are generally outside the control of the trapper and may influence the amount of effort invested in trapping. Several external factors have well-documented effects on trapping effort, such as fur values (Daigle, Muth, Zwick, & Glass, 1998; Gosselink, Van Deelen, Warner, & Joselyn, 2003; McDonald & Harris, 1999), fuel prices (Brinkman et al., 2014; Schumacher, 2013), furbearer abundances (DeVink et al., 2011), and weather conditions (McDonald & Harris, 1999; Yom-Tov, Yom-Tov, MacDonald, & Yom-Tov, 2007). Trapping effort may be influenced by a combination of these factors.

Studies during the 1990s and early 2000s indicated that fur values controlled trapping effort (Daigle et al., 1998; Gese, 2001; Gosselink et al., 2003; McDonald & Harris, 1999). However, recent studies suggest a possible shift in motivations, with economics playing a lesser role (Hiller, Etter, Belant, & Tyre, 2011; Landriault, Naylor, Mills, & Baker, 2012; S. M. Webb, 2009). This shift may be attributed to higher fur values from the 1990s–2000s compared to prices in 2014 (Fur Harvesters Auction Incorporated, 2014; Hiller, 2011; United States Department of Agriculture, 2014).

The price of fuel may also be a key economic influence on trapping effort. Trappers concerned with money likely reduce trapping effort when the price of fuel is high, and increase effort when fuel is inexpensive. A recent study found that Alaska residents participating in subsistence activities, including trapping, reduced their effort in relation to high fuel prices (Brinkman et al., 2014). The distance traveled to the trapline, length of trapline, and frequency of checking a trapline all must be taken into consideration when fuel is used to power transportation for trapping.

A potential influence in the decision to trap is the likelihood that an animal will be

caught. Perceived fluctuations in furbearer populations may dictate trapping effort if trappers are motivated by catching animals (DeVink et al., 2011). If populations are low, trappers my not expend effort on trapping, a labor intensive activity. Conversely, if there is a higher likelihood that an animal could be caught, trappers may want to increase trapping effort for a better chance at increasing catch.

Weather can influence furbearer populations (Landriault et al., 2012; Swanson & Johnson, 1999) and may also influence trapping effort (Banci & Proulx, 1999; Yom-Tov et al., 2007). If temperatures are extremely cold, some trappers may be unmotivated to trap extensively. Alaskan winter temperatures typically remain well below freezing. Running a long trapline may become dangerous in these conditions, particularly in the remote, road-less wilderness that characterizes much of Alaska. Conversely if temperatures are too warm, trapping conditions may become poor due to frequent melt/freeze cycles and less snow. Cumulative snowfall may also affect trapping due to ease of transportation. The introduction of snowmobiles in the 1960s changed how people were able to trap (Francis, 1969). This new mode of travel allowed trappers to cover large areas without needing to tend to dog teams year round. The ability to travel long distances reliably made snowmobiles an important mode of transportation in the North (Banci & Proulx, 1999). However, this advantage is reduced if there is not enough snow to travel across the landscape.

Social factors

Unlike external factors such as weather, social issues can be controlled but are likely complex and may be difficult to change. These issues have the same potential to influence trapping effort as external factors. Human conflict, difficulty accessing land, and low trapper recruitment all have the potential to reduce trapping effort (Gese, 2001; Siemer et al., 1994;

Zwick, Glass, Royar, & Decker, 2002). These conflicts are difficult to navigate, as solving one side of the argument may intensify the conflict for the opposite side. For example, enforcing a leash law could make trappers happy, but anger pet owners.

Due to these conflicts, individuals may alter trapping effort to avoid confrontations. In Alaska, trapping laws are liberal compared with other states (e.g. Alaska Department of Fish and Game, 2014; Minnesota Department of Natural Resources, 2014). There are no required trap check intervals, few limits on how many animals can be taken, and trappers have the right to cut a trapping trail on state land (Alaska Department of Fish and Game, 2014; Alaska Department of Natural Resources, 2015). The unique chance to create a trapping trail on state land benefits the trapper by allowing a longer trapline. However, this creates potential conflicts among trappers and the public. A set of unwritten "rules" exists among trappers pertaining to trapping trails on public land. When a trapper cuts a trail, it is considered to be his/her trail, though legal rights of the trail are not retained by the individual (Alaska Department of Natural Resources, 2015). When other trappers encroach on a trail, conflicts are likely to occur. These conflicts may inhibit trappers from attaining their desired amount of trapping effort, or prohibit them from trapping. To reduce conflicts among trappers, Canadian furbearer managers created a registration system awarding trapline rights to an individual trapper (Canadian Wildlife Services, 2014). This system has the potential to reduce conflicts over trapline rights (Robichaud & Boyce, 2010). However, attaining a trapline becomes difficult due to competition for a set number of available traplines (Slough & Jessup, 1996).

Since traplines on state land in Alaska are open to the public, they become popular places for people to walk, snowshoe, ski, or travel by snowmobile. Inevitably, conflicts between recreationalists and trappers arise when traps are disturbed, animals in traps stolen, or when pets

get caught in traps. Other states have restricted trapping due to the public outcry caused by pets caught in traps. For example, Colorado initiated a ban on many trap types and increased regulation on trapping as a result of a public ballot initiative in 1996 (Manfredo, Fulton, & Pierce, 1997). Trappers avoid areas where conflicts with the public are likely, which reduces their effort.

Accessing land becomes difficult when attempting to avoid both competition from other trappers and conflicts with the public (Siemer et al., 1994). Access to land directly influences trapping effort by the placement and length of traplines (Banci & Proulx, 1999; Landriault et al., 2012; Zwick et al., 2002). Trappers that live in densely populated areas have increased competition for local trapping access. Roads influence access to traplines, increasing competition for trapline establishment (Landriault et al., 2012). When new roads are created, access increases, and trapping effort should increase as well.

Trapping participation has declined in the United States since the 1980s (Daigle et al., 1998; Muth et al., 1996; Siemer et al., 1994). In Alaska, trapping license sales declined between the 1980s and 1990s (Andersen, 1993) but increased in 2014 to levels similar to the 1980s (Alaska Department of Fish and Game, 2015). However, these recent numbers may not be an accurate measure of active trappers. If one wishes to shoot a marmot (*Marmota spp.*), marten (*Martes spp.*), mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), river otter (*Lontra canadensis*), or weasel (*Mustela erminea*), a trapping license is required (Alaska Department of Fish and Game, 2014). Therefore all who purchase a combination license (hunting-trapping, hunting-fishing-trapping) do not necessarily trap. Without a direct measure of active trappers, it is difficult to assess fluctuations in trapping participation. Determining the number of active trappers directly impacts trapping effort. Daigle et al. (1998) stated that there are many

contributors to declines in trapping participation including "…destruction of furbearer habitat for industrial and municipal development, the decline in pelt prices, the posting of private land, forest fragmentation due to residential development, and the increasing political influence of the animal rights movement".

Moderation

Motivations to trap may moderate the influence of both external factors and social issues on trapping effort. A moderator has the potential to influence the strength and direction of the relationship between the independent and dependent variables (Baron & Kenny, 1986). Several studies used knowledge as a moderator to explain the strength and direction the influence of values and attitudes on behaviors (e.g. Glikman, Vaske, Bath, Ciucci, & Boitani, 2012; Manfredo et al., 1997; Tarrant, Bright, & Ken Cordell, 1997; Thapa, Graefe, & Meyer, 2005). For example, Glikman et al. (2012) looked at the combined influence of cognitions (i.e. impact beliefs) and affect (i.e., feelings) on normative beliefs about wolf (*Canis lupus*) and brown bear (*Ursus arctos*) management decisions in the Abnizzo Lazio and Molise National Parks in central Italy. They found that knowledge moderated the relationship between beliefs and feelings in support of certain management actions. In my study, the dependent variable was trapping effort, the independent variables included external factors and social issues, and the moderator was trapper motivations. Grouping trappers based on motivations may allow for differences in the impact of social issues and external variables to be quantified and related to changes in trapping effort. Understanding these differences among trappers may aid managers in determining and predicting trapping effort over the course of a particular season.

Study concept

To shed light on the factors affecting trapping effort, Chapter 1 details several

overarching themes in determining the motivations, external factors, and social issues that affect trappers in interior Alaska. A questionnaire was sent to trappers in interior Alaska in the spring of 2014 (Appendix A). Motivational questions characterized trappers to determine different reasons for trapping. Answers to the questions helped group trappers based on their motivations. These groups described the dominant motivations to trap in interior Alaska. I explored how external factors and social issues influenced trapping effort among groups. If differences were detected among groups, I determined moderation to be present with respect to the influence of external factors and social issues on trapping effort. Knowing how external factors or social issues affect trapping effort will aid in decisions to include effort in indices of abundance based on harvest. The results of this research can be used by managers to shape management decisions based on the motivations of the trappers.

Chapter 2 analyzes data from the Alaska Department of Fish and Game's (ADF&G) Alaska Trapper Questionnaire (Appendix B, sent to a randomly selected portion of Alaskan trappers between 2004 and 2013, excluding 2010 when no survey was conducted) to determine if trapping effort is an important metric to adjust harvest based abundance indices. I compared data on effort and harvest to determine if a relationship existed between the variables. I hypothesized that fur harvest would increase with trapping effort, and that trapping effort would be influenced by external factors. I examined data on fur values, fuel prices, average winter temperatures, and cumulative snow fall in ADF&G game management regions 1 through 5 to determine the most important variable(s) influencing effort. I hypothesized that low temperatures would negatively affect effort because of the danger of extreme cold. I also hypothesized that trapping effort would differ among ADF&G, game management regions in relation to land access. These results can be used by managers to determine if effort should be used to glean more accurate harvest based

abundance indices.

References

Alaska Department of Fish and Game. (2014). 2013-2014 Alaska trapping regulations. 54. from http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulaitions.trapping

Alaska Department of Fish and Game. (2015). License statistics. from http://www.adfg.alaska.gov/index.cfm?adfg=licensevendors.statistics

Alaska Department of Natural Resources. (2015). Public information center. from http://dnr.alaska.gov/commis/pic/faq.htm

Andersen, D. B. (1993). *Trapping in Alaska and the European Economic Community import ban on furs taken with leghold traps*. Juneau, Alaska, USA: Alaska Department of Fish and Game, Division of Subsistence.

Armstrong, J. B., & Rossi, A. N. (2000). Status of avocational trapping based on the perspectives of state furbearer biologists. *Wildlife Society Bulletin, 28*(4), 825-832.

Bailey, T. N. (1981). *Characteristics, trapping techniques, and views of trappers on a wildlife refuge in Alaska* Paper presented at the Proceedings of the Worldwide Furbearer Conference, Frostburg, Maryland, USA.

Banci, V., & Proulx, G. (1999). Resiliency of furbearers to trapping in Canada. *Alpha Wildlife Research & Management, Sherwood Park, Alta*, 175-204.

Baranov, F. I. (1918). *On the question of the biological basis of fisheries*. Ithaca, New York, USA: Cornell University.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology, 51*(6), 1173.

Beverton, R., & Holt, S. (1957). *On the dynamics of exploited fish populations*. London, England, UK: Ministry of Agriculture.

Brinkman, T., Maracle, K. B., Kelly, J., Vandyke, M., Firmin, A., & Springsteen, A. (2014). Impact of fuel costs on high-latitude subsistence activities *Ecology and Society, 19*(4), 18.

Brodie, J. F., & Post, E. (2010). Nonlinear responses of wolverine populations to declining winter snowpack. *Population ecology, 52*(2), 279-287.

Canadian Wildlife Services. (2014). The Registered Trapline System and the Lineholder. Retrieved 11/13, 2014, from http://www.manitoba.ca/conservation/////wildlife/trapping/rtl_lines.html

Chilelli, M., Griffith, B., & Harrison, D. J. (1996). Interstate comparisons of river otter harvest data. *Wildlife Society Bulletin*, 238-246.

Daigle, J. J., Muth, R. M., Zwick, R. R., & Glass, R. J. (1998). Sociocultural dimensions of trapping: A factor analytic study of trappers in six northeastern states. *Wildlife Society Bulletin*, 614-625.

deCalesta, D. (1976). Predator control: History and policies. *Oregon State University Extension Service*. Retrieved from: https://ir.library.oregonstate.edu/xmlui/bitstream.handle/1957/24333/ECNO710-B.pdf?sequence=1

Decker, D. J., Brown, T. L., & Gutierrez, R. (1980). Further insights into the multiple-satisfactions approach for hunter management. *Wildlife Society Bulletin*, 323-331.

DeVink, J.-M., Berezanski, D., & Imrie, D. (2011). Comments on Brodie and Post: harvest effort: The missing covariate in analyses of furbearer harvest data. *Population ecology, 53*(1), 261-262.

Dolin, E. J. (2010). *Fur, fortune, and empire: The epic history of the fur trade in America*. New York, New York, USA: WW Norton & Company.

Francis, K. E. (1969). Decline of the dogsled in villages of arctic Alaska: A preliminary discussion. *Yearbook of the Association of Pacific Coast Geographers, 31*(1), 69-78.

Fur Harvesters Auction Incorporated. (2014). Auction Results. from http://furharvesters.com/auctionresults.html

Gese, E. M. (2001). *Monitoring of terrestrial carnivore populations*. Fort Collins, Colorado, USA: National Wildlife Research Center.

Glikman, J. A., Vaske, J. J., Bath, A. J., Ciucci, P., & Boitani, L. (2012). Residents' support for wolf and bear conservation: The moderating influence of knowledge. *European Journal of Wildlife Research, 58*(1), 295-302.

Gosselink, T. E., Van Deelen, T. R., Warner, R. E., & Joselyn, M. G. (2003). Temporal habitat partitioning and spatial use of coyotes and red foxes in east-central Illinois. *The Journal of Wildlife Management*, 90-103.

Gowans, F. (2009). *Rocky mountain rendezvous: A history of the fur trade rendezvous 1825 - 1840* Layton, Utah, USA: Gibbs Smith.

Gulland, J. (1964). Catch per unit effort as a measure of abundance. *Rapports et Procèsverbaux des Réunions Conseil International pour l'Exploitation de la Mer, 155*, 8-14.

Hafen, L. R. (1995). *Fur traders, trappers, and mountain men of the upper Missouri*. Lincoln, Nebraska, USA: University of Nebraska Press.

Harley, S. J., Myers, R. A., & Dunn, A. (2001). Is catch-per-unit-effort proportional to abundance? *Canadian Journal of Fisheries and Aquatic Sciences, 58*(9), 1760-1772.

Hendee, J. C. (1974). A multiple-satisfaction approach to game management. *Wildlife Society Bulletin*, 104-113.

Hendee, J. C., & Potter, D. R. (1971). *Human behavior and wildlife management: Needed research.* Paper presented at the Transactions of the North American Wildlife and Natural Resources Conference.

Hill, E. P. (1976). *Control methods for nuisance beaver in the southeastern United States.* Paper presented at the 7th Vertebrate Pest Conference, Monterey, California, USA.

Hiller, T. L. (2011). Oregon Furbearer Program Report (Oregon Department of Fish and Wildlife, Trans.). Salem, OR.

Hiller, T. L., Etter, D. R., Belant, J. L., & Tyre, A. J. (2011). Factors affecting harvests of fishers and American martens in northern michigan. *The Journal of Wildlife Management, 75*(6), 1399-1405.

Kellert, S. (1981). *Trappers and trapping in American society.* Paper presented at the Proceedings of the Worldwide Furbearer Conference, Frostburg, Maryland, USA.

Landriault, L. J., Naylor, B. J., Mills, S. C., & Baker, J. A. (2012). Evaluating the relationship between trapper harvest of American martens (*Martes americana*) and the quantity and spatial configuration of habitat in the boreal forests of Ontario, Canada. *The Forestry Chronicle, 88*(3), 317-327.

Manfredo, M. J., Fix, P. J., Teel, T. L., Smeltzer, J., & Kahn, R. (2004). Assessing demand for big-game hunting opportunities: applying the multiple-satisfaction concept. *Wildlife Society Bulletin, 32*(4), 1147-1155.

Manfredo, M. J., Fulton, D. C., & Pierce, C. L. (1997). Understanding voter behavior on wildlife ballot initiatives: Colorado's trapping amendment. *Human Dimensions of Wildlife, 2*(4), 22-39.

Maunder, M. N., Sibert, J. R., Fonteneau, A., Hampton, J., Kleiber, P., & Harley, S. J. (2006). Interpreting catch per unit effort data to assess the status of individual stocks and communities. *ICES Journal of Marine Science: Journal du Conseil, 63*(8), 1373-1385.

McCullough, D. R., & Carmen, W. J. (1982). Management goals for deer hunter satisfaction. *Wildlife Society Bulletin*, 49-52.

McDonald, R. A., & Harris, S. (1999). The use of trapping records to monitor populations of stoats *Mustela erminea* and weasels *M nivalis*: The importance of trapping effort. *Journal of Applied Ecology, 36*(5), 679-688.

Minnesota Department of Natural Resources. (2014). *Minnesota Hunting/Trapping Regulations*. St. Paul, MN: Retrieved from http://dnr.state.mn.us/regulations/hunting/index.html.

Muth, R. M., Daigle, J. J., Zwick, R. R., & Giass, R. J. (1996). Trappers and trapping in advanced industrial society: Economic and socio-cultural values of furbearer utilization in the northeastern United States. *Sociological Spectrum, 16*(4), 421-436.

Naske, C., & Slotnick, H. (1994). *Alaska: A history of the 49th state*. Norman, Oklahoma, USA: University of Oklahoma Press.

Osgood, C. (1940). *Ingalik material culture*. New Haven, Connecticut, USA: Yale University Press

Poole, K., & Mowat, G. (2001). Alberta furbearer harvest data analysis (Sustainable Resource Development Fish and Wildlife Division, Trans.) *Alberta Species at Risk Report* (pp. 51). Edmonton, Alberta, CA.

Ray, A. J. (1998). *Indians in the fur trade: Their role as trappers, hunters, and middlemen in the lands southwest of Hudson Bay, 1660-1870: with a New Introduction*. Toronto, Ontario, CA: University of Toronto Press.

Robichaud, C. B., & Boyce, M. S. (2010). Spatial and temporal patterns of wolf harvest on registered traplines in Alberta, Canada. *The Journal of Wildlife Management, 74*(4), 635-643.

Rose, G., & Kulka, D. (1999). Hyperaggregation of fish and fisheries: How catch-per-unit-effort increased as the northern cod (*Gadus morhua*) declined. *Canadian Journal of Fisheries and Aquatic Sciences, 56*(S1), 118-127.

Royama, T. (1992). *Analytical population dynamics* (Vol. 10). London, England, UK: Springer.

Schumacher, T. (2013). Trapper Questionnaire. Juneau, Alaska, USA: Alaska Department of Fish and Game.

Serfass, T. L., Peper, R. L., Whary, M. T., & Brooks, R. P. (1993). River otter (*Lutra canadensis*) reintroduction in Pennsylvania: Prerelease care and clinical evaluation. *Journal of Zoo and Wildlife Medicine*, 28-40.

Siemer, W. F., Batcheller, G. R., Glass, R. J., & Brown, T. L. (1994). Characteristics of trappers and trapping participation in New York. *Wildlife Society Bulletin, 22*(1), 100-111.

Slough, B. G., & Jessup, R. H. (1996). Furbearer trapping in the Yukon, Canada *Assessing the Sustainability of Uses of Wild Species*. Gland, Switzerland: International Union for Conservation of Nature.

Smith, L. M., Brisbin, I. L., & White, G. C. (1984). An evaluation of total trapline captures as estimates of furbearer abundance. *The Journal of Wildlife Management, 48*(4), 1452-1455.

Swanson, B. J., & Johnson, D. R. (1999). Distinguishing causes of intraspecific synchrony in population dynamics. *Oikos*, 265-274.

Tarrant, M. A., Bright, A. D., & Ken Cordell, H. (1997). Attitudes toward wildlife species protection: Assessing moderating and mediating effects in the value-attitude relationship. *Human Dimensions of Wildlife, 2*(2), 1-20.

Thapa, B., Graefe, A. R., & Meyer, L. A. (2005). Moderator and mediator effects of scuba diving specialization on marine-based environmental knowledge-behavior contingency. *The Journal of Environmental Education, 37*(1), 53-67.

Todd, A. W. (1987). A method of prioritizing furbearer species for research and development in humane capture methods as applied in Canada. *Wildlife Society Bulletin, 15*(3), 372-380.

Todd, A. W., & Boggess, E. K. (1987). Characteristics, activities, lifestyles, and attitudes of trappers in North America. In M. Novak (Ed.), *Wild Furbearer Management and Conservation in North America* (pp. 59-76). Ontario, CA: Ontario Trappers Association.

United States Department of Agriculture. (2014). Mink (National Agricultural Statistics Service, Trans.) *Mink Pelt Production*. Washington, D.C.: Agricultural Statistics Board.

Webb, M. (1985). *The last frontier: A history of the Yukon Basin of Canada and Alaska*. Albuquerque, New Mexico: University of New Mexico Press.

Webb, S. M. (2009). Marten fur harvests and landscape change in west-central Alberta. *The Journal of Wildlife Management, 73*(6), 894-903.

Webb, S. M., Davidson, D. J., & Boyce, M. S. (2008). Trapper attitudes and industrial development on registered traplines in west-central Alberta. *Human Dimensions of Wildlife, 13*(2), 115-126.

Wilson, D. E., Cole, F. R., Nichols, J. D., Rudran, R., & Foster, M. S. (1996). *Measuring and monitoring biological diversity: Standard methods for mammals* (Vol. 409). Washington, DC, USA: Smithsonian Institution Press

Winterhalder, B. P. (1980). Canadian fur bearer cycles and Cree-Ojibwa hunting and trapping practices. *American Naturalist*, 870-879.

Yom-Tov, Y., Yom-Tov, S., MacDonald, D., & Yom-Tov, E. (2007). Population cycles and changes in body size of the lynx in Alaska. *Oecologia, 152*(2), 239-244.

Zwick, R. R., Glass, R. J., Royar, K., & Decker, T. (2002). Sociocultural perspectives of trapping revisited: A comparative analysis of activities and motives 1994 and 2000. 118-123.

Chapter 1: Motivations of fur trappers in interior Alaska[1]

Abstract

Understanding how and why trapping effort varies among fur trappers is necessary to accurately interpret trends in fur harvest for wildlife management. We mailed a questionnaire to 1,760 fur trappers in interior Alaska to characterize the motivations for trapping and primary factors affecting trapping effort. A cluster analysis revealed four groups with distinct motivations for trapping: wildlife management (17% of trappers), recreational (39%), subsistence (18%), and solitary (26%). The most important external factor and social issue affecting trapping effort were perceived furbearer abundance and access to land, respectively. Economic gain was the least important motivation for trapping among respondents. Our results suggest that effort should fluctuate more in response to furbearer populations than to changes in fur prices. Our findings suggest that managers seeking to maintain or increase satisfaction among trappers should focus on reducing human conflicts and maximizing the non-monetary benefits of trapping.

Key words trapping, motivations, trapping effort, furbearer management, Alaska.

[1] Dorendorf, R., Fix, P., and Prugh, L. The Motivations of Fur Trapping in Interior Alaska. In preparation for submission to *The Human Dimensions of Wildlife*.

Introduction

Monitoring changes in furbearer population and harvest levels, as well as factors contributing to these changes, is necessary to make sound management decisions. Fur harvest records are commonly used as indices of furbearer population trends, but we currently lack information about how external factors (e.g. weather, fur value, gas prices), social issues (e.g. human conflict, access to land), and motivations (e.g. outdoor recreation, escape and relaxation) affect trapping effort. Motivations to trap could play a moderating role, altering the effect of social issues and external factors on trapping effort. A better understanding of the relationship between motivations, social and external factors, and trapping effort is needed to improve the accuracy of harvest-based abundance indices.

Because furbearers occur at low densities and are elusive, obtaining accurate estimates of their populations is difficult (Becker, 1991; Skalski et al., 2011). Although advances such as genetic mark-recapture make population estimation feasible (Mumma, Zieminski, Fuller, Mahoney, & Waits, 2015; Tom, 2012), this method is prohibitively expensive for routine management purposes. Therefore, most wildlife management agencies use fur harvest trends as indices of abundance (Gese, 2001; Hiller, Etter, Belant, & Tyre, 2011; Royama, 1992). However, this method has been criticized for not including a measure of effort invested in trapping (DeVink, Berezanski, & Imrie, 2011; Smith, Brisbin, & White, 1984; Winterhalder, 1980). Variables such as fuel and fur prices, temperature, and social conflict may be important in determining how much effort trappers invest in trapping, which in turn could influence harvest levels. Understanding the various forces that change effort is necessary for managers to accurately interpret changes in harvest patterns.

We conducted a self-administered, mail-back questionnaire of trappers in interior Alaska

to examine motivations and factors affecting trapping effort. Trapping is an important cultural, subsistence, recreational, and economic activity in Alaska (Schwanke & Burch, 2010; Wolfe, 1991), and the Alaska Department of Fish and Game (ADF&G) monitors harvest trends as an index of furbearer abundance. Since 1989, ADF&G has distributed a post-season questionnaire to trappers to monitor trends in furbearer harvest. Total trapping effort is monitored through the questionnaire, but it does not include questions about motivations for trapping, nor does it measure the strength of external factors and social issues affecting trappers.

People may trap for a variety of reasons, such as nature appreciation, escape and relaxation, personal achievement, wildlife use and management, affiliation with other trappers, cultural ties, and economics (Gese, 2001; Kellert, 1981; Muth et al., 2006; Siemer, Batcheller, Glass, & Brown, 1994; Todd, 1987; Todd & Boggess, 1987). A combination of these motivations likely plays into the decision to trap (Todd & Boggess, 1987). These motivations are complex and numerous (Manfredo, Driver, & Tarrant, 1996). Motivations were used to describe how managers could increase the satisfactions of hunters using a multiple-satisfaction approach to wildlife management (Hendee, 1974; Hendee & Potter, 1971). Instead of managing wildlife with one goal in mind (e.g. consumptive use), the multiple-satisfaction framework brought to light the various reasons people engaged in outdoor activities. For example, hunters may participate in white-tailed deer (*Odocoileus virginianus*) hunting to be with family and friends, be a part of nature, and to feel a sense of accomplishment. Varying motivational characteristics have been demonstrated between hunters belonging to different hunting groups (e.g., casual, intermediate, focused, veteran; Needham, Vaske, Donnelly, & Manfredo, 2007). This multiple-satisfaction framework was used to characterize motivations of trappers as well (Daigle, Muth, Zwick, & Glass, 1998; Peek, 2000; Siemer et al., 1994). Bailey (1981) conducted the only study

about trapping motivations in Alaska and found outdoor experience to be the most important motivation for trapping. Trapping effort may vary among trappers with different motivations, and trappers in different motivational groups may also be differentially affected by external factors and social issues.

There are many external factors that could affect trapping effort. These include fur prices (Daigle et al., 1998; Gosselink, Van Deelen, Warner, & Joselyn, 2003; McDonald & Harris, 1999), fuel prices (Brinkman et al., 2014; Schumacher, 2013), furbearer species abundances (DeVink et al., 2011), and weather conditions (Yom-Tov, Yom-Tov, MacDonald, & Yom-Tov, 2007). Fur trapping was very lucrative during the 1920's (Andersen, 1993), but fur prices have since declined. Yet a resilient group of trappers continues to participate today. Previous studies have found that fur values play a key role in trapper participation (Siemer et al., 1994), but more recent evidence shows that this motivation has become weaker (e.g., Fortin & Cantin, 2005; Hiller et al., 2011; Kapfer & Potts, 2012). Weather may also affect trapping effort due to extreme fluctuations in temperature, which may influence snow conditions that can hinder trap function and travel on the trapline. There is evidence that these external factors influence trapping effort (Banci & Proulx, 1999; Gese, 2001; Landriault, Naylor, Mills, & Baker, 2012), but insufficient data are currently available to determine which have the greatest influence.

Social issues pertaining to trapping may also influence effort. Increased urbanization, reduced access to land, and the animal rights movement have all contributed to recent declines in trapper participation across the U.S. (Daigle et al., 1998; Jung & Slough, 2011). Although participation in trapping is still relatively high in Alaska, the proportion of licensed trappers in Alaska has declined steadily since the 1980s (Alaska Department of Fish and Game, 2015; Andersen, 1993). This decline may be attributed to low trapper recruitment, anti-trapping

sentiment, conflicts with other trappers, conflicts with recreationalists, and difficulty finding access to land. In Canada, governments typically require that traplines be registered, except in some cases on private or government-owned land (Canadian Wildlife Services, 2014). These regulations may reduce conflicts over trapline ownership (Canadian Wildlife Services, 2014). Alaska does not have registered traplines, and the majority of public land is open to trapping. It is legal for trappers to cut trails (less than 5 feet wide) on designated state land, although trappers have no legal rights to trails they create (Alaska Department of Natural Resources, 2015). An informal system exists where traplines are kept and maintained by those who originally cleared the trail. These trails may be legally use by other trappers and recreationalists, which may result in conflict over trail use. These social issues and external factors may influence the effort of all trappers in a similar way. Alternatively, trappers may respond to these factors differentially based on their motivations to trap.

The objectives of this study were to: (1) characterize motivations of interior Alaskan trappers, (2) identify and describe unique groups of trappers, and (3) identify the primary social issues and external factors influencing each group's trapping effort. We predicted that the most important motivation for trapping would be nature appreciation, as shown in more recent studies (Zwick, Muth, & Solan, 2006). We also predicted that motivations would moderate the influence that both external factors and social issues have on trapping effort (Figure 1.1).

Methods

Study area and study population

We defined the study area as "interior" Alaska (Figure 1.2) which includes game management units 12, 19-21, 24 and 25 (Alaska Department of Fish and Game, 2014). To identify trappers operating in the study area, we obtained physical addresses of trapping license

holders in 2012 from ADF&G. This included all persons who purchased a trapping license (trapping, combination hunting-trapping, and hunting-fishing-trapping licenses) during 2012. We assumed addresses within interior Alaska belonged to trappers that trapped in the interior during the 2012 trapping season, which we later verified by respondents' indication of the game management unit in which they trapped. Trappers with physical addresses outside of the interior were not included in the study.

Data collection

Determination of sample size. In 2012, 4,194 people bought trapping licenses in interior Alaska. We used Raosoft (2004) to determine that a sample of 352 useable questionnaires would provide adequate statistical power to address our research objectives. Therefore, we mailed questionnaires to 1,760 trappers, conservatively estimating we would receive a 20% response rate. We assumed the response to our survey would be lower than the 32.6% average response rate to the Alaska Trapper Questionnaire, which has been mailed to licensed trappers throughout Alaska since 1989 (Schumacher, 2013). Trapping license holders between the ages of 16-60 years old received a questionnaire. Trappers over the age of 60 years old have the option of obtaining a permanent identification card for hunting, fishing and trapping instead of a trapping license in Alaska. We could not differentiate between card-holders that trapped and those that did not, and thus excluded them from the study.

Questionnaire design. To guide development for our questionnaire, we conducted 16 semi-structured interviews (Appendix C) by telephone and in person to explore external factors and identify social issues that may influence trapping effort of interior Alaskan trappers. We used content analysis to identify common themes (Krippendorff, 2013). Interviewees then received a pilot questionnaire and we refined questions based on their feedback. After testing, the

final questionnaire contained a 22 item scale to measure social issues, a 26 item scale to measure external factors, and a 30 item scale to measure motivations.

We presented social issues that could affect trapping effort as statements and measured responses on a seven-point Likert scale with endpoints *strongly disagree* and *strongly agree*. We provided a list of external factors that could affect trapping effort to the respondents, with responses measured on a seven-point Likert scale with end points *significantly decrease effort* and *significantly increase effort*. Interviews aided in the development of two motivation items: subsistence use of wildlife and economics. We drew upon the literature for the remainder of motivation items: nature appreciation, exercise, lifestyle orientation, affiliation, wildlife management, escape and relaxation, and personal achievement (Daigle et al., 1998; Siemer et al., 1994). The motivations were measured with a seven-point Likert scale with endpoints *strongly disagree* and *strongly agree*. To explore differences among trappers, the final section contained questions about trapping effort (number of individual traplines, length of each trapline in miles, months spent trapping, and the number of traps and snares set during the 2013-2014 season), questions about general demographics (population of town/village, age, and race), and general questions about trapping habits (mode of transportation on trapline, proportion of income earned from trapping). We recorded effort and demographic questions with a combination of fill in the blank, and multiple choice answers (e.g. population of residence: < 100, 101 – 500, 501 – 1000, 1001 – 5000, > 5000).

Mailings. This study was approved by the University of Alaska–Fairbanks Institutional Review Board (IRB; permit numbers: 536124-1, 536124-2; Appendix D and E). In accordance with IRB rules, we contacted only individuals 18 years of age and older (Institutional Review Board, 2014).

We used the Dillman Total Design Method (Dillman, 2011) to maximize the response rate. To announce the study, we sent a post card (Appendix F) for initial contact in April, near the end of the 2013-2014 trapping season. We mailed the questionnaire with a cover letter (Appendix G) two weeks after the post card. The original list of trappers contained an error, where 1,265 of 1,855 mail recipients purchased a combination hunting-fishing license rather than a form of trapping license (1,855 was based on the original incorrect list of 10,492 trappers/hunters). Thus, only 590 questionnaire recipients actually purchased a trapping license in 2012. We therefore drew a random sample of 1,170 recipients from a corrected list for a total of 1,760 recipients out of a total of 4,194 who purchased a trapping license in 2012. We sent the initial contact post card to the additional recipients four weeks after the original mailing, followed by the questionnaire one week later. Seven weeks after the initial contact post card, we sent a reminder post card (Appendix H). Eight and ten weeks after the initial contact postcard, we sent a second questionnaire and a third questionnaire along with a modified cover letter (Appendix I). We randomly chose five people who returned completed questionnaires to receive $50 gas gift cards three weeks after the final mailing. This small reward provided extra incentive to return fully completed questionnaires.

Non-response bias

We conducted a non-response bias test through brief telephone interviews to see if a random selection of non-respondents differed from respondents. We used a shortened version of the questionnaire during interviews to reduce respondent burden. These interviews contained only key questions such as whether individuals trapped, which external factors affected their trapping effort, their current issues of concern, their motivations, the number of months they spent trapping, and the number of traps and snares they typically set in one season.

Statistical analyses

We used the Statistical Package for the Social Sciences (Version 23) to transform variables and conduct all statistical analyses. We used exploratory factor analysis (EFA) for data reduction using a verimax rotation with principal-components extraction. To determine internal consistency of scales created through EFA, we used Cronbach's alpha coefficient (Cronbach, 1951). We then calculated new variables from the mean of the merged items. To identify groups of trappers with similar motivational characteristics, we used a k-means cluster analysis with an ipsative transformation. To detect the presence of moderation, we used one-way ANOVAs to determine whether trapping effort and the importance of social issues and external factors differed among identified trapper groups. Scheffé's and Tamhane's T2 (for unequal variances) post hoc tests were used to identify differences among trapper groups. We used chi-squared tests to determine how specific levels of external factors (e.g. snow depth, temperature) affected participation in trapping, and to see if demographics differed among groups. We calculated trapping effort as:

trapping effort = # *traps and snares set* × *length of trapline (km)* × *weeks trapped*

We used a significance level of $p < .05$ for all tests.

Results

Of the 1,760 mailings sent to trappers, 149 were returned as undeliverable, for a total sample of 1,611 potentially eligible trapping license holders. We received a total of 617 responses after allowing 4.5 months (mid-April through September 2013) for response, for a 38.3% response rate. Of the 617 respondents, 273 stated that they had never trapped, leaving a total sample of 344 eligible respondents that completed questionnaires for our analyses. Of the eligible respondents, 65% were from towns with greater than 500 people, and 35% were from

villages with fewer than 500 people. This ratio is similar to that of the initial mailings, where 70% were sent to residents of towns with greater than 500 people and 30% were sent to residents of villages with fewer than 500 people.

We contacted 25 non-respondents by telephone for a 6-question survey based on the questionnaire (Appendix J). Forty percent of these non-respondents said they did not complete the questionnaire because they had never trapped. This percentage is close to the percentage of respondents stating they had never trapped before (44%). The remaining 60% of non-respondents did not respond for other reasons, such as being out of mail contact, or having recently moved. Non-respondents reported furbearer abundance, weather, access to land, and human conflict as the most common external factors and social issues influencing their trapping effort. Since non-respondents appeared to be similar to respondents, we did not weight the data.

Data reduced to seven factors created from the original nine based on eigenvalues greater than one (Table 1.1). We interpreted factor loadings from exploratory factor analysis greater than .5 as a strong relationship between questions (Morgan, Gliner, & Harmon, 2006). The first factor loaded on items from "nature appreciation" and "personal fitness", which ranged from .684-.827, and .718-.723, respectively. Based on high factor loadings, and the theoretical overlap of the domains, we determined that the two constructs should be combined to form a new construct called "outdoor recreation". The item "affiliation with others" scored .450-.465 for factors three and six respectively. However, based on the Cronbach's alpha value of .777 and that both factors were loaded on, we combined these two scores to retain a fourth factor called "affiliation with others".

We set the minimum Cronbach's alpha level at .600 as suggested in the literature (Peterson, 1994; Vaske, 2008; Table 1.1). Reliability of all items within motivations ranged from

.777-.894 (Table 1.1). Variables with an alpha value of .600 or higher were averaged within each scale, while those lower were not combined (Table 1.1; Appendix K and L).

A four-group solution provided the clearest distinctions between trapper motivational groups based on a k-means cluster analysis (Table 1.2). We named the first group of trappers "management," because they scored the highest among groups on the wildlife management factor. Trappers in this group made up 17% of the respondents ($n = 57$). The second group scored highest among groups for the outdoor recreational factor, and thus we named them "recreational" ($n = 125$). Group three, named "subsistence," scored highest among groups on the factor for subsistence use of wildlife, which totaled 18% of respondents ($n = 58$). The fourth group, named "solitary," scored highest among groups on personal achievement, and relatively high on the outdoor recreational factor. This group represented 26% of the respondents ($n = 85$).

Several key differences helped to distinguish these trapper groups. The management group had more traplines than both the solitary group and recreational group ($F(3) = 8.49$, $p < .001$, Scheffé's post hoc tests $p < .001$, $p = .023$, respectively). The majority of trappers fell under the recreational group (39% of respondents). This group had the lowest mean trapping effort compared to the management, subsistence, and solitary groups (Figure 1.3; $F(3) = 9.525$, $p < .001$, Scheffé's post hoc tests $p = .001$, $p = .002$, $p = .007$, respectively). The recreational group also scored lowest among groups on the economics factor (ipsative transformed mean = -1.61). The subsistence group scored highest for economics, although with a relatively low ipsative score of 0.06. Trapping comprised a larger proportion of yearly income (> 21% of total income) for subsistence trappers compared to others ($\chi^2(3) = 32.939$, $p < .001$, Cramer's V = .325). Subsistence trappers were most likely to live in a town/village with 500 or fewer people ($\chi^2(12) = 64.648$, $p < .001$, Cramer's V = .261). Solitary trappers scored lowest on the affiliation with

others factor (Table 1.2).

The most important external factors to all trappers were furbearer abundance and personal issues. Although abundance of furbearers was an important issue to trappers in all groups, the subsistence group was less likely to increase trapping effort when furbearer populations were high compared to the management and recreational groups ($F(3) = 3.96$, $p = .009$, Sheffé's post hoc tests $p = .037$, $p = .019$ respectively). Personal factors that influence trapping effort differed among trapper groups. The recreational group differed from the management, subsistence, and solitary groups ($F(3) = 7.41$, $p < .001$, Scheffé's post hoc tests $p = .002$, $p = .023$, $p = .008$ respectively), with a lower mean score indicating reduced effort when they had poor health, family commitments, or a lack of free time.

Trappers from all groups agreed that access to land and human conflict were the most important social issues. Scheffé's post hoc tests indicated no significant differences among trapper groups with respect to the relative importance of social issues.

The majority of respondents actively trapped in 2012 (58%), but a large portion (42%) did not for a variety of reasons. The most common reason for not trapping during the 2013-2014 season was a lack of free time (39%). Other reasons included: lack of trapping equipment (13%), health issues (11%), low furbearer populations (7%), family commitments (6%), change in residence (6%), competition from other trappers (4%), disinterest (4%), poor weather (2%), price of fuel (1%), and other (7%). Fur prices were not listed as a reason for not trapping.

Discussion

Outdoor recreation proved to be the most important motivation to trap in interior Alaska. This finding supports results from other studies of trapper motivations indicating that outdoor experience (Bailey, 1981), interaction with nature (Glass, More, & DiStefano, 1992), nature

appreciation (Peek, 2000), and spending time outdoors (Siemer et al., 1994) were either the most or second most important motivations for trapping. Trapping is a consumptive wildlife activity along with fishing, hunting, and gathering wild edible plants (Daigle et al., 1998; Zwick et al., 2006), which all have similar benefits through the commonality of being outdoors. Outdoor recreation may be an important motivation in Alaska during winter months as a way to get exercise and appreciate nature when there is little daylight and temperatures often stay well below freezing for months at a time.

Many trappers reported that "doing something challenging", and "testing my skills and abilities" were important motivations to trap. The unique history of trapping in Alaska by European settlers began in the 1800s (Andersen, 1993), and connecting with this past lifestyle is still a source of pride for trappers today. Trappers reported motivations for trapping such as "important part of lifestyle", and to "participate in favorite activity". This result is similar to other studies reporting lifestyle orientation as a motivation to trap (Daigle et al., 1998; Zwick, Glass, Royar, & Decker, 2002; Zwick et al., 2006). Lifestyle orientation may be especially important in Alaska because of its prominent trapping history. Today trapping, hunting, and fishing create a unique personal identity that is another reason for Alaskans to participate in these activities. Both lifestyle orientation and the challenge and reward of trapping may connect Alaskans to the history of their land and foster a sense of pride in Alaska as the "Last Frontier."

Contrary to historic roots of trapping, economic and subsistence uses of wildlife scored among the least important motivations to trap in this study (Table 1.2). The importance of these factors likely changed as society advanced with lightweight, insulated, and waterproof clothing, along with changes in clothing style preferences. Although fur remains a lucrative business for a few trappers, trapping license sales have decreased since the 1980s in Alaska (Andersen, 1993)

and elsewhere (Daigle et al., 1998; Siemer et al., 1994; Webb, Davidson, & Boyce, 2008). However, other studies still highlight the importance of economics in trapper motivations (Gehrt, Hubert Jr, & Ellis, 2002; Peck & Heidt, 1985; Tumlison & McDaniel, 1986). Our study corroborates with more recent research showing that pelt price is not an important influence on trapping effort (Hiller et al., 2011; Kapfer & Potts, 2012; Landriault et al., 2012). The relatively high importance of economics to the subsistence group of trappers, which were most likely to live in areas with fewer than 500 people and rely on a greater portion of income from trapping, shows that trapping is an economically important activity in rural villages, which is similar to findings in Canada (Stabler, Tolley, & Howe, 1990).

The low reported influence of economics on trapping effort indicates that income from trapping is secondary to the experience of trapping itself. If fur prices increased several-fold, trappers that normally would not participate may decide to actively trap (Gehrt et al., 2002; Peck & Heidt, 1985; Tumlison & McDaniel, 1986), thus mirroring results of studies mentioned above who found that income from trapping was important to trappers. Increased effort in relation to pelt price also depends on species abundance, ease of catch and pelt preparation, and regulations (Banci & Proulx, 1999; Kapfer & Potts, 2012). For example, the relationship between muskrat harvest and pelt price was stronger from 1948-1968 when pelt prices were higher compared to 1986-2006 when prices were relatively low (Roberts & Crimmins, 2010). This pattern supports the notion that large changes in price may influence harvest (Roberts & Crimmins, 2010). However, compared to 2013 prices, minor price fluctuations are not likely to significantly change trapping effort. Therefore, it is unlikely that minor changes in prices of fur and fuel would strongly affect patterns of harvest or the validity of harvest as an index of furbearer abundance. However, quantitative analyses examining patterns of trapper effort and prices over

time are needed to rigorously examine how strongly price fluctuations affect effort.

This study was unable to survey people who do not trap unless fur prices are high. Although our non-response bias test suggested that our sample was unbiased, we were restricted to sampling trappers who purchased trapping licenses. If a sizeable proportion of trappers in interior Alaska do not purchase trapping licenses due to low fur values and differ in motivations and effort compared to license holders, our results would then apply only to licensed trappers and not the trapping community as a whole.

Assisting with wildlife management was the primary motivation for trappers in the management group. Alaska has a history of manipulating its wildlife populations through intensive management (Boertje, Keech, & Paragi, 2010), because reducing predator populations can increase the abundance of prey species such as moose and caribou (Boertje et al., 2010; Boertje, Valkenburg, & McNay, 1996; Keech, 2012). Predator reduction motivates some trappers who also participate in other consumptive outdoor activities such as fishing and hunting (Daigle et al., 1998; Zwick et al., 2006).

The recreational group was the largest, containing 38% of respondents. This group scored highest on the outdoor recreation factor, showing that trapping is a way for people in this group to appreciate nature and get exercise. This group had the lowest score among groups on the economic factor, which indicates that money was not an important motivating factor (Table 1.2). To increase trapper satisfaction, managers should maximize the recreational aspects of trapping (Siemer et al., 1994) with education programs focusing not only on the legal and ethical methods of trapping, but on the broader spectrum of motivations for trapping such as an learning about nature and participating in an Alaskan tradition. If fur prices continue to drop, the continuation of trapping as a pastime and tool for wildlife management hinges on groups like this to continue

participating in trapping regardless of changes in external factors such as fur prices.

Trapping is a lifestyle orientation for subsistence trappers. These trappers typically live in small villages that have few economic opportunities (Brinkman et al., 2014). These communities traditionally use fur for cultural crafts and ceremonies, as well as a source of income in the winter. The characteristics of these communities form their unique group from the need to survive physically and culturally. It is particularly important for managers to attempt to maintain healthy populations of furbearers around these communities because of the cultural and economic importance of trapping to the community members. This may be achieved with the support and cooperation between resource managers and the community members. For example, land management that reduces the abundance of mature spruce forests which marten (*Martes spp.*) rely on (Wiebe, Fryxell, Thompson, Börger, & Baker, 2013) could adversely affect these communities by reducing populations of marten, which are the most important species for trappers in Alaska accounting for an average of 25% of total catch (Schumacher, 2013).

Though the outdoor recreation and personal achievement factors proved important for the solitary group and the recreational group, the solitary group's low score on "affiliation with others" set them apart. Trapping can be a solitary pursuit to isolate oneself from society, and the desire for solitude motivates certain trappers to participate. This group may be affected more than other groups by human conflict issues that disturb their solitude. Our study indicates that focusing on reducing conflicts amongst trappers and with the public would be the most effective way to improve trapper satisfaction among all trapper groups, and these actions could be especially beneficial for solitary trappers.

When furbearer populations were high, trappers in the recreational and management groups indicated they would increase trapping effort more than trappers in the subsistence group.

The lack of an increase in effort by subsistence trappers may occur because subsistence trappers maintain a relatively high effort irrespective of population levels. It is likely very difficult for managers to keep all furbearer populations high, particularly since our understanding of what drives populations is continually changing (Koskela et al., 2013; Mech & Boitani, 2010; O'Donoghue et al., 1998; Paragi, Johnson, Katnik, & Magoun, 1996), and there are many variables that are out of the managers control (e.g. harsh winters). This uncertainty exemplifies the importance of tracking trapper harvest and effort annually so managers can index furbearer trends over time. Because trapping effort mirrors furbearer abundance (DeVink et al., 2011), patterns of change in fur harvest are likely amplified in relation to changes in furbearer abundance. We therefore recommend monitoring and accounting for changes in trapper effort when harvest is used as an index of furbearer abundance.

Trapper groups differed in how their effort changed due to their health, family commitments and available free time. The recreational group differed from all other groups, with a greater reduction in effort when stricken with these personal issues. As a recreational pursuit, trapping effort would be expected to decrease with sickness, but if for example one depended on trapping for a higher portion of income as is the case for subsistence trappers, trapping becomes a vocation, not just a recreational activity. In such instances this may force trappers to maintain their effort regardless of their state of health. Likewise, having free time and family commitments may be more important to recreational trappers compared to other groups because their main motivation is to fulfill satisfactions such as appreciating nature and exercise, compared to the subsistence and management groups which have strong motivations to trap based on wildlife management or the subsistence use of wildlife. Available time and personal health were also found to influence participation of trappers in the northeastern United States

(Zwick et al., 2002), supporting a change in historical inhibitors to trapping such as price of fur. The effect of personal issues on effort may increase the variation in harvest among individual trappers, thereby decreasing the precision of fur harvest as an index of abundance.

Opinions on social issues did not differ among trapper groups, and access to land and human conflict were important social issues to all trappers. Though public land is plentiful in interior Alaska, all groups stated that finding access to land for trapping was difficult. In Alaska, there are many unwritten "rules" that influence trappers based on tradition and are open to interpretation. These "rules" tend to lead to conflicts among trappers and/or with the public. No laws exist to govern trapline ownership in Alaska, which may challenge law enforcement officials with more frequent instances of conflict resolution. Crowding may also be a reason for the difficulty of recruiting and maintaining active trappers since competition for traplines is highest near heavily populated areas in the interior such as the Fairbanks North Star Borough. This problem may also contribute to difficulty for a novice trapper to find access to land that is not occupied by other trappers. The lack of access to traplines may contribute to the difficulty of recruiting new trappers. Managers should support and encourage trapper education to reduce conflicts among trappers and between trappers and the public. Education may inform novice trappers on unwritten "rules" so they can respectfully establish traplines without encroaching on other trappers' grounds. These "rules" could be taught as basic etiquette for all trappers to follow through required trapper education.

Conclusion

Although we identified four groups of trappers with distinct motivations, the social issues and external factors had similar effects on the effort of all trappers. Therefore, managers can expect similar reactions to variables such as changes in fur values, weather, furbearer

populations, human conflicts, and access to land regardless of the motivations to trap in interior Alaska. The most important of these issues were access to land and furbearer populations, and the greatest motivation for trapping was outdoor recreation. When using trapping effort to adjust harvest based indices of abundance, managers should account for the influence of motivations, external factors, and social issues. Furbearer managers should incorporate questions pertaining to motivations, external factors, and social issues in annual trapping surveys in order to understand changes in motivations to trap and potential forces that may change trapping effort, participation, and harvest.

References

Alaska Department of Fish and Game. (2014). 2013-2014 Alaska trapping regulations. 54. from http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulaitions.trapping

Alaska Department of Fish and Game. (2015). License statistics. from http://www.adfg.alaska.gov/index.cfm?adfg=licensevendors.statistics

Alaska Department of Natural Resources. (2015). Public information center. from http://dnr.alaska.gov/commis/pic/faq.htm

Andersen, D. B. (1993). *Trapping in Alaska and the European Economic Community import ban on furs taken with leghold traps*. Juneau, Alaska, USA: Alaska Department of Fish and Game, Division of Subsistence.

Bailey, T. N. (1981). *Characteristics, trapping techniques, and views of trappers on a wildlife refuge in Alaska* Paper presented at the Proceedings of the Worldwide Furbearer Conference, Frostburg, Maryland, USA.

Banci, V., & Proulx, G. (1999). Resiliency of furbearers to trapping in Canada. *Alpha Wildlife Research & Management, Sherwood Park, Alta*, 175-204.

Becker, E. F. (1991). A terrestrial furbearer estimator based on probability sampling. *The Journal of Wildlife Management*, 730-737.

Boertje, R. D., Keech, M. A., & Paragi, T. F. (2010). Science and values influencing predator control for Alaska moose management. *The Journal of Wildlife Management, 74*(5), 917-928.

Boertje, R. D., Valkenburg, P., & McNay, M. E. (1996). Increases in moose, caribou, and wolves following wolf control in Alaska. *The Journal of Wildlife Management*, 474-489.

Brinkman, T., Maracle, K. B., Kelly, J., Vandyke, M., Firmin, A., & Springsteen, A. (2014).

Impact of fuel costs on high-latitude subsistence activities *Ecology and Society, 19*(4), 18.

Canadian Wildlife Services. (2014). The Registered Trapline System and the Lineholder. Retrieved 11/13, 2014, from http://www.manitoba.ca/conservation/////wildlife/trapping/rtl_lines.html

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297-334.

Daigle, J. J., Muth, R. M., Zwick, R. R., & Glass, R. J. (1998). Sociocultural dimensions of trapping: A factor analytic study of trappers in six northeastern states. *Wildlife Society Bulletin*, 614-625.

DeVink, J.-M., Berezanski, D., & Imrie, D. (2011). Comments on Brodie and Post: harvest effort: The missing covariate in analyses of furbearer harvest data. *Population ecology, 53*(1), 261-262.

Dillman, D. A. (2011). *Mail and Internet surveys: The tailored design method--2007 Update with new Internet, visual, and mixed-mode guide*. Hoboken, New Jersey, USA: John Wiley & Sons.

Fortin, C., & Cantin, M. (2005). Harvest status, reproduction and mortality in a population of American martens in Quebec, Canada *Martens and Fishers (Martes) in Human-Altered Environments* (pp. 221-234): Springer.

Gehrt, S. D., Hubert Jr, G. F., & Ellis, J. A. (2002). Long-term population trends of raccoons in Illinois. *Wildlife Society Bulletin*, 457-463.

Gese, E. M. (2001). *Monitoring of terrestrial carnivore populations*. Fort Collins, Colorado, USA: National Wildlife Research Center.

Glass, R. J., More, T. A., & DiStefano, J. J. (1992). Vermont trappers: characteristics, motivations, and attitudes. *Trans. Northeast Sect. Wildl. Soc, 48*, 134-143.

Gosselink, T. E., Van Deelen, T. R., Warner, R. E., & Joselyn, M. G. (2003). Temporal habitat partitioning and spatial use of coyotes and red foxes in east-central Illinois. *The Journal of Wildlife Management*, 90-103.

Hendee, J. C. (1974). A multiple-satisfaction approach to game management. *Wildlife Society Bulletin*, 104-113.

Hendee, J. C., & Potter, D. R. (1971). *Human behavior and wildlife management: Needed research.* Paper presented at the Transactions of the North American Wildlife and Natural Resources Conference.

Hiller, T. L., Etter, D. R., Belant, J. L., & Tyre, A. J. (2011). Factors affecting harvests of fishers and American martens in northern michigan. *The Journal of Wildlife Management, 75*(6), 1399-1405.

Institutional Review Board. (2014, September 30, 2014). Institutional Review Board. from http://www.uaf.edu/irb/

Jung, T. S., & Slough, B. G. (2011). The status of fisher (Martes pennanti) at the northwestern edge of their range: are they increasing and expanding in the Yukon? *Northwestern Naturalist, 92*(1), 57-64.

Kapfer, P. M., & Potts, K. B. (2012). Socioeconomic and ecological correlates of bobcat harvest in Minnesota. *The Journal of Wildlife Management, 76*(2), 237-242.

Keech, M. A. (2012). *Response of moose and their predators to wolf reduction and short-term bear removal in a portion of Unit 19D.* Juneau, Alaska, USA: Alaska Department of Fish and Game, Division of Wildlife Conservation.

Kellert, S. (1981). *Trappers and trapping in American society.* Paper presented at the Proceedings of the Worldwide Furbearer Conference, Frostburg, Maryland, USA.

Koskela, A., Kaartinen, S., Aspi, J., Kojola, I., Helle, P., & Rytkönen, S. (2013). Does grey wolf presence affect habitat selection of wolverines? *Annales Zoologici Fennici, 50*(4), 216-224.

Krippendorff, K. (2013). *Content analysis: An introduction to its methodology* (M. Byrnie Ed. 3 ed.). Thousand Oaks, California: SAGE Publications Inc.

Landriault, L. J., Naylor, B. J., Mills, S. C., & Baker, J. A. (2012). Evaluating the relationship between trapper harvest of American martens (*Martes americana*) and the quantity and spatial configuration of habitat in the boreal forests of Ontario, Canada. *The Forestry Chronicle, 88*(3), 317-327.

Manfredo, M. J., Driver, B. L., & Tarrant, M. A. (1996). Measuring leisure motivation: A meta-analysis of the recreation experience preference scales. *Journal of Leisure Research, 28*(3), 188-213.

McDonald, R. A., & Harris, S. (1999). The use of trapping records to monitor populations of stoats *Mustela erminea* and weasels *M nivalis*: The importance of trapping effort. *Journal of Applied Ecology, 36*(5), 679-688.

Mech, L. D., & Boitani, L. (2010). *Wolves: Behavior, ecology, and conservation*. Chicago, Illinois: University of Chicago Press.

Morgan, G. A., Gliner, J. A., & Harmon, R. J. (2006). *Understanding and evaluating research in applied and clinical settings*. Mahwah, New Jersey, USA: Psychology Press.

Mumma, M. A., Zieminski, C., Fuller, T. K., Mahoney, S. P., & Waits, L. P. (2015). Evaluating noninvasive genetic sampling techniques to estimate large carnivore abundance.

Molecular ecology resources.

Muth, R. M., Zwick, R. R., Mather, M. E., Organ, J. F., Daigle, J. J., & Jonker, S. A. (2006). Unnecessary source of pain and suffering or necessary management tool: Attitudes of conservation professionals toward outlawing leghold traps. *Wildlife Society Bulletin, 34*(3), 706-715.

Needham, M. D., Vaske, J. J., Donnelly, M. P., & Manfredo, M. J. (2007). Hunting specialization and its relationship to participation in response to chronic wasting disease. *Journal of Leisure Research, 39*(3), 413-437.

O'Donoghue, M., Boutin, S., Krebs, C. J., Zuleta, G., Murray, D. L., & Hofer, E. J. (1998). Functional responses of coyotes and lynx to the snowshoe hare cycle. *Ecology, 79*(4), 1193-1208.

Paragi, T. F., Johnson, W., Katnik, D. D., & Magoun, A. J. (1996). Marten selection of postfire seres in the Alaskan taiga. *Canadian journal of zoology, 74*(12), 2226-2237.

Peck, J. H., & Heidt, G. A. (1985). A model to predict Arkansas gray fox fur harvests. *Arkansas Academy of Science Proceedings, 39*.

Peek, M. S. (2000). *Attitudes and characteristics of Kansas trappers (Master's thesis).* Emporia State University, Emporia, Kansas, USA.

Peterson, R. A. (1994). A meta-analysis of Cronbach's coefficient alpha. *Journal of consumer research*, 381-391.

Raosoft. (2004). Sample Size Calculator. from http://www.raosoft.com/samplesize.html

Roberts, N. M., & Crimmins, S. M. (2010). Do trends in muskrat harvest indicate widespread population declines? *Northeastern Naturalist, 17*(2), 229-238.

Royama, T. (1992). *Analytical population dynamics* (Vol. 10). London, England, UK: Springer.

Schumacher, T. (2013). Trapper Questionnaire. Juneau, Alaska, USA: Alaska Department of Fish and Game.

Schwanke, A. R., & Burch, M. (2010). Furbearer management report of survey-inventory activities (W. Conservation, Trans.). In P. Harper (Ed.), (pp. 130-141). Juneau, Alaska, USA.

Siemer, W. F., Batcheller, G. R., Glass, R. J., & Brown, T. L. (1994). Characteristics of trappers and trapping participation in New York. *Wildlife Society Bulletin, 22*(1), 100-111.

Skalski, J. R., Millspaugh, J. J., Clawson, M. V., Belant, J. L., Etter, D. R., Frawley, B. J., & Friedrich, P. D. (2011). Abundance trends of American martens in Michigan based on statistical population reconstruction. *The Journal of Wildlife Management, 75*(8), 1767-1773.

Smith, L. M., Brisbin, I. L., & White, G. C. (1984). An evaluation of total trapline captures as estimates of furbearer abundance. *The Journal of Wildlife Management, 48*(4), 1452-1455.

Stabler, J. C., Tolley, G., & Howe, E. C. (1990). Fur trappers in the Northwest Territories: An econometric analysis of the factors influencing participation. *Arctic*, 1-8.

Statistical Package for the Social Sciences (Version 23). (2013). [Computer software]: Armonk, New York, USA: IBM Corporation.

Todd, A. W. (1987). A method of prioritizing furbearer species for research and development in humane capture methods as applied in Canada. *Wildlife Society Bulletin, 15*(3), 372-380.

Todd, A. W., & Boggess, E. K. (1987). Characteristics, activities, lifestyles, and attitudes of trappers in North America. In M. Novak (Ed.), *Wild Furbearer Management and Conservation in North America* (pp. 59-76). Ontario, CA: Ontario Trappers Association.

Tom, B. M. (2012). *A comparison of noninvasive survey methods for monitoring mesocarnivore populations in Kentucky (Master's thesis).* University of Kentucky, Lexington Kentucky.

Tumlison, R., & McDaniel, V. (1986). Harvest trends of the bobcat (*Felis rufus*) in Arkansas. *Proceedings Arkansas Academy of Science, 40*, 78-81.

Vaske, J. J. (2008). *Survey research and analysis: Applications in parks, recreation and human dimensions*: Venture Publishing State College, PA.

Webb, S. M., Davidson, D. J., & Boyce, M. S. (2008). Trapper attitudes and industrial development on registered traplines in west-central Alberta. *Human Dimensions of Wildlife, 13*(2), 115-126.

Wiebe, P. A., Fryxell, J. M., Thompson, I. D., Börger, L., & Baker, J. A. (2013). Do trappers understand marten habitat? *The Journal of Wildlife Management, 77*(2), 379-391.

Winterhalder, B. P. (1980). Canadian fur bearer cycles and Cree-Ojibwa hunting and trapping practices. *American Naturalist*, 870-879.

Wolfe, R. J. (1991). *Trapping in Alaska communities with mixed, subsistence-cash economies*. Juneau, Alaska, USA: Division of Subsistence, Alaska Department of Fish and Game.

Yom-Tov, Y., Yom-Tov, S., MacDonald, D., & Yom-Tov, E. (2007). Population cycles and changes in body size of the lynx in Alaska. *Oecologia, 152*(2), 239-244.

Zwick, R. R., Glass, R. J., Royar, K., & Decker, T. (2002). Sociocultural perspectives of trapping revisited: A comparative analysis of activities and motives 1994 and 2000. 118-123.

Zwick, R. R., Muth, B., & Solan, D. (2006). *A longitudinal comparison of activities and motives of Vermont trappers: 1994, 2000, and 2005.* Paper presented at the Proceedings of the 2006 Northeastern Recreation Research Symposium, Bolton Landing, New York

Tables

Table 1.1

Exploratory factor analysis and reliability analysis of motivations to trap

Reason for trapping	n	Percent of respondents			Factor loading	Cronbach's alpha (α)
		Disagree	Agree	Neither		
Outdoor recreation						0.894
Enjoy nature	333	1.2	96.7	2.1	0.741	
Learn about wildlife	332	1.5	91.3	7.2	0.814	
Observing wildlife	332	1.8	91	7.2	0.827	
Getting exercise	332	3.6	86.1	10.2	0.718	
Staying in shape	333	3.9	83.8	12.3	0.723	
Feel like I am a part of nature	330	2.7	79.7	17.6	0.684	
Personal achievement						0.857
Doing something challenging	338	2.7	87.3	10.1	0.768	
Test my skills and abilities	338	3.3	86.4	10.4	0.746	
Feeling a sense of accomplishment	330	5.5	82.1	12.4	0.549	
Being self-sufficient	339	6.5	79.4	14.2	0.54	
Lifestyle orientation						0.846
Important part of lifestyle	340	4.7	83.2	12.1	0.748	
Participate in favorite activity	338	4.7	79.3	16	0.627	
Maintain tradition	337	4.7	76	19.3	0.758	
Remain in touch with heritage	337	6.2	68	25.8	0.707	
Affiliation with others						0.777
Spending time with family and friends	338	7.1	68.9	24	0.465	
Teach others to trap	338	7.4	67.8	24.9	0.45	
Competing with others	337	46.9	12.2	40.9	-	
Escape or relaxation						0.832
Getting a chance to spend time alone	331	6.9	73.4	19.6	0.555	
Time to think	332	8.7	62	29.2	0.769	
For a change of routine	331	13.6	54.1	32.3	0.799	
Getting away from everyday problems	332	14.8	53.3	31.9	0.797	
Wildlife management						0.816
Predator control	339	10.9	69.3	19.8	0.774	
Manage furbearer populations	336	11.9	61.8	26.3	0.624	
Nuisance wildlife control	337	16.9	49.3	33.8	0.806	
Subsistence use of wildlife						0.796
Use furbearers to make clothes	338	8.3	74.9	16.9	0.8	

Table 1.1 continued...

Reason for trapping	n	Percent of respondents			Factor Loading	Cronbach's alpha (α)
		Disagree	Agree	Neither		
Subsistence use of wildlife						
Use furbearers for food	336	28.9	39.9	31.3	0.727	
Economic						0.855
For a little extra spending money	339	18	61.7	20.4	0.696	
To supplement family income	340	19.4	52.4	28.2	0.783	
Provide main source of income	338	39.6	26.3	34	0.781	

Note. Percentage of respondents that agreed, disagreed or neither on motivations for trapping in interior Alaska, USA in 2013. n = sample size; α = Cronbach's alpha. Cells containing (-) were not retained in the motivational scale.

Table 1.2

Mean motivational scores by cluster group

Motivation scales	Management (Group 1) $n = 57$	Recreational (Group 2) $n = 125$	Subsistence (Group 3) $n = 58$	Solitary (Group 4) $n = 85$
Outdoor recreation	0.62^{ac} $(6.08)^{a}$	0.91^{b} $(6.32)^{a}$	0.34^{ac} $(5.48)^{b}$	0.89^{ab} $(6.11)^{a}$
Escape and relaxation	-1.18^{a} $(4.22)^{a}$	0.29^{b} $(5.54)^{b}$	-0.84^{c} $(4.27)^{a}$	0.15^{b} $(5.43)^{b}$
Personal achievement	0.25^{a} $(5.63)^{abcd}$	0.55^{b} $(5.89)^{abd}$	-0.01^{a} $(5.15)^{ac}$	0.84^{c} $(6.06)^{abd}$
Wildlife management	0.60^{a} $(5.99)^{a}$	-0.29^{b} $(4.77)^{b}$	-1.08^{c} $(4.07)^{c}$	-0.01^{d} $(5.22)^{b}$
Subsistence use of wildlife	-0.45^{a} $(4.98)^{a}$	-0.35^{a} $(4.71)^{a}$	0.53^{b} $(5.74)^{b}$	-1.08^{c} $(4.11)^{c}$
Affiliation with others	0.63^{a} $(6.00)^{a}$	0.24^{b} $(5.46)^{b}$	0.18^{b} $(5.33)^{b}$	-0.86^{c} $(4.39)^{c}$
Economic	-0.67^{a} $(4.61)^{a}$	-1.61^{b} $(3.28)^{b}$	0.06^{c} $(5.21)^{a}$	-0.15^{c} $(5.09)^{a}$
Lifestyle orientation	0.19^{a} $(5.61)^{abc}$	0.26^{a} $(5.52)^{ab}$	0.83^{b} $(6.03)^{ac}$	0.22^{a} $(5.48)^{ab}$

Note. A Likert scale ranging from 1 = *strongly disagree*, 4 = *neutral*, 7 = *strongly agree* was used to record respondents' motivations. Respondents' answers to variables were reduced through factor analysis to an 8 item scale of motivations. A k-means cluster analysis was used to group similar responses into trapper types. Numbers in parentheses are the original means for the scale. Answers outside the parentheses are the ipsative transformed score (z-score) based on the original mean. Sheffé's post hoc tests were conducted for both the ipsative value and the original mean. Numbers with different superscripts (^{abcd}) shown represent tests that were significant at $p < .05$.

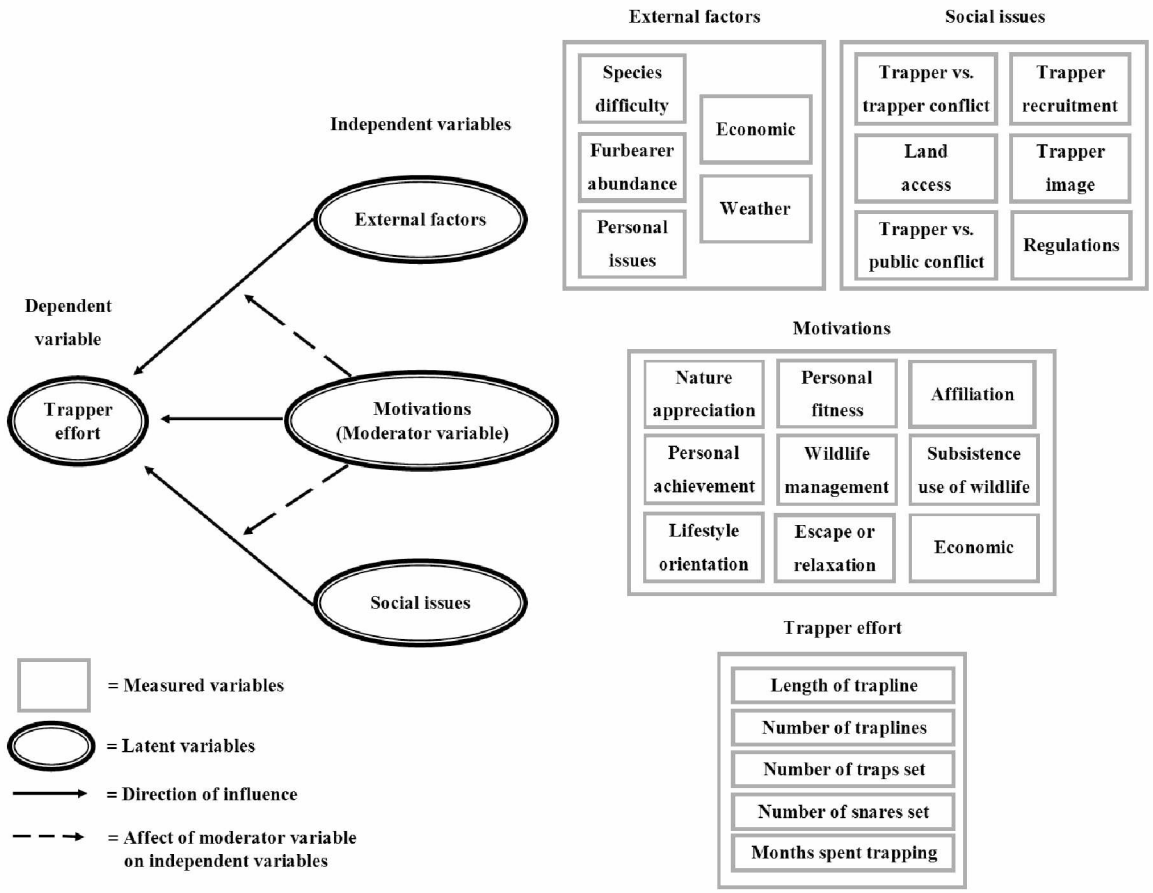

Figure 1.1. Conceptual model representing independent, dependent, and moderator variables. Variables in boxes represent measured variables from the questionnaire. Ovals represent latent variables, influenced by measured variables. The independent variables (external factors, motivations, and social issues) all influence the dependent variable (trapping effort).

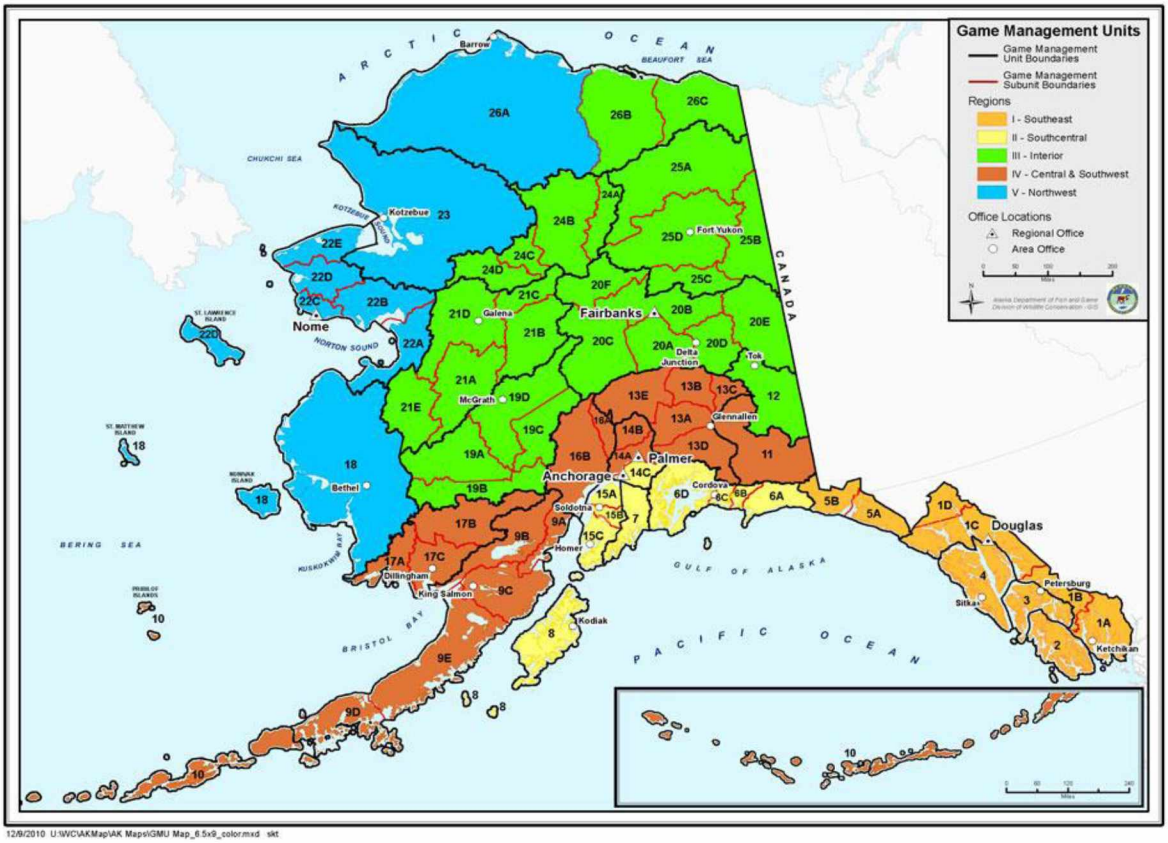

Figure 1.2. Map of game management units in Alaska, USA. For this study, game management units 12, 19-21, 24, and 25 are defined as "interior" Alaska (Alaska Department of Fish and Game, 2014).

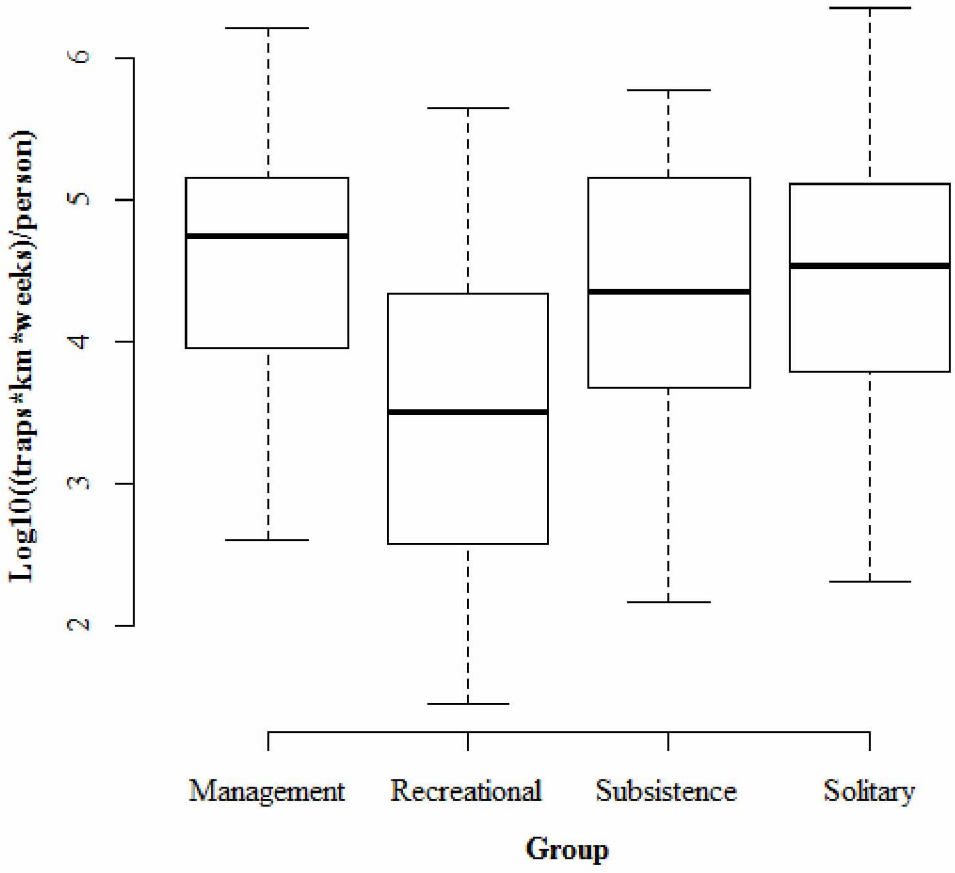

Figure 1.3. Average trapping effort among groups during the 2013-2014 trapping season in Alaska, USA. Trapping effort was measured as the average number of traps and snares set × trapline length (km) × weeks trapped, per person. Central horizontal lines show means, boxes show 25th and 75th quartiles, and whiskers show 95% CIs. Effort was log transformed to meet assumptions of normality.

Chapter 2: Furbearer harvest in Alaska: an evaluation of trends in catch and effort[1]

Abstract Catch per unit effort (CPUE) is a commonly used index of abundance for harvested species such as fish. However, raw catch statistics are generally used as indices of furbearer abundance, and it is currently unknown how strongly trapping effort may affect fur harvest. Using a data set based on questionnaires mailed to trappers throughout Alaska from 2004-2013 by the Alaska Department of Fish and Game (n = 5,538 trappers), we examined the relationship between trapping effort and catch. In addition, we examined the effect of fur values, fuel prices, average winter temperatures, cumulative snowfall, road availability, and human population on trapping effort. As expected, total fur harvest increased with total effort across years, but the relationship was surprisingly weak (R^2 = 0.125). Because species-specific information on effort was not collected, we were unable to determine whether a stronger relationship between catch and effort existed for individual species. Winter temperature and road availability were the only external factors that affected trapping effort across the state. Contrary to our expectations, colder temperatures resulted in increased effort, which may have been due to increased freeze-thaw cycles in warm weather and increased difficulty of travel. Of the five game management regions in Alaska, Region 3 (interior Alaska) had the highest effort per trapper, which was likely due to the relatively high road access in this region. We recommend managers collect species- and region specific information on catch and effort to improve measures of CPUE for furbearer populations.

Keywords Alaska, abundance, catch-per-unit-effort, furbearers, harvest, trapping effort.

[1] Dorendorf, R., and Prugh, L. Furbearer Harvest in Alaska: An Evaluation of Trends in Catch and Effort. In preparation for submission to *The Wildlife Society Bulletin*.

Introduction Accurately monitoring trends in big game, furbearer, and fish populations is crucial to the sustainable consumptive use of these harvested resources. Although scientifically rigorous surveys are used to monitor some populations, these methods are too expensive to apply to all harvested populations (Gese 2001). In many cases, harvest statistics are the primary means of monitoring population trends (Royama 1992, Brodie and Post 2010). In fisheries, harvest (i.e., catch) is typically adjusted to account for variation in effort, which results in catch-per-unit-effort (CPUE), a metric commonly used to monitor trends in fish stocks (Harley et al. 2001). However, furbearer management typically relies on unadjusted harvest statistics to track trends in abundance, and effort is rarely tracked (Kapfer and Potts 2012). Without adjusting harvest to account for variation in trapping effort, raw harvest statistics may be inaccurate indices of abundance (DeVink et al. 2011).

The objective of this study was to examine the relationship between trapping effort and catch of furbearers, and to determine how strongly external factors affect trapping effort. We used a data set from an annual trapping questionnaire distributed by the Alaska Department of Fish and Game (ADF&G) to address these objectives (Appendix B). Trapping is important both as a strong cultural activity and as a tool for management of furbearers in North America. In Alaska, trapping is an especially important economic, cultural, and social activity (Andersen 1993). In recent years, however, trapper participation has been decreasing in the United States (Armstrong and Rossi 2000, Vantassel et al. 2010). Decreases in trapper effort could result in a decline in fur harvest, and this pattern may be interpreted as a population decline when harvest records alone are used to assess furbearer population trends. Accurate estimates of abundance are vital to ensure informed management decisions and to manage a sustainable harvest of furbearers. Several authors have called for the use of CPUE rather than harvest alone to monitor furbearer

populations (Chilelli et al. 1996, Wilson et al. 1996, Poole and Mowat 2001), but these data are often unavailable. Currently, ADF&G uses abundance estimates derived from harvest records to set limits on furbearer harvest in locations such as southcentral Alaska (Schwanke and Burch 2010). However, most of Alaska has no limit on the number of furbearers, regardless of species, that can be taken through trapping during the trapping season (Alaska Department of Fish and Game 2014). These laws are far more liberal than other U.S. states such as Minnesota which has stricter limits on catch (Minnesota Department of Natural Resources 2014). Although some furbearer populations are closely monitored in certain areas. Alaska's liberal regulations intensify the need to monitor harvest and effort to understand trends in abundance of all furbearer species.

Understanding external factors that affect trapping effort could help managers to account for changes in effort even if direct metrics of effort are unavailable. Predictors that have been found to explain trapping effort include fur values (Daigle et al. 1998, McDonald and Harris 1999, Gosselink et al. 2003), price of fuel (Schumacher 2013, Brinkman et al. 2014), temperature (Stabler et al. 1990, Yom-Tov et al. 2007, Landriault et al. 2012), and snow depth (Chapter 1) Of these external factors, temperature may have the greatest influence on trapping effort in Alaska. Winter temperatures well below freezing can be dangerous to trappers. "Important" furbearers (rated by trappers through ADF&G's Alaska Trapper Questionnaire; Schumacher 2013) such as American marten (*Martes americana*) are more active in mild temperatures, and therefore trapper effort likely increases with warmer temperatures as well (Landriault et al. 2012). Stabler et al. (1990) found that an increase in average winter temperature by one degree Celsius led to an increase of 61 trappers in Northern Canada. Cumulative snowfall may also play a key role in trapping effort. In arctic and sub-arctic regions, trapline travel is primarily by snowmobile (Banci

and Proulx 1999, DeVink et al. 2011, Schumacher 2013). Snowmobiles are the most efficient means of travel in areas with few roads. If cumulative snowfall is low, trapline logistics may become difficult, thus reducing trapping effort.

Beyond climatic conditions, economic factors have been linked to trapping effort and other subsistence activities (Banci and Proulx 1999, Brinkman et al. 2014). Fur values have been decreasing since the 1980s (Andersen 1993), and the proportion of Alaskans buying licenses in the first decade of the 21st century was lower than in the 1980s (Andersen 1993, Alaska Department of Fish and Game 2015). In addition to fur values, the price of fuel plays a role in the decision to trap (Schumacher 2013). Increasing fuel prices since the beginning of the 21st century (Haire and Machemehl 2007), have made participation in subsistence trapping expensive for residents of small communities in Alaska (Brinkman et al. 2014). Because most trappers in interior Alaska do not rank money made from trapping as a motivation to trap (Chapter 1), we predicted fur and fuel prices would not strongly affect trapping effort.

Factors affecting trapping effort may vary considerably across the vast state of Alaska. The state is divided into 5 game management regions (Fig. 2.1; Alaska Department of Fish and Game 2014), and habitats span from coastal rainforest to arctic tundra. Individual trapping effort may vary among regions due to differential access to land, human population, trapping culture, or other factors that vary geographically. Alaska is typified by low human population density and few roads throughout most of the state, with 59.2% of the state's population concentrated in the municipalities of Juneau, Anchorage, and Fairbanks in Regions 1, 2, and 3 respectively (United States Census Bureau 2010). We predicted that regions containing these population centers would have lower levels of effort per trapper than other regions due to heightened competition for traplines and a relatively high proportion of recreational trappers rather than subsistence

trappers (Chapter 1). Alternatively, regions with population centers could have higher per-trapper effort because the presence of roads in these regions may increase access. Roads provide ease of access to land suitable for hunting (Brinkman et al. 2007). This could be the case for trapping as well, since the majority of trappers in Alaska use roads to access their traplines (Schumacher 2013).

Based on the importance of incorporating CPUE into harvest-based population indices that has been demonstrated by fisheries research, we hypothesized that trapping effort would have a strong effect on catch. We also hypothesized that temperature would negatively affect trapping effort statewide more than fur values, fuel prices, or cumulative snowfall. We also hypothesized that trapping effort would have a negative relationship with human population, and alternatively, a positive relationship with cumulative road length, in each region of Alaska.

Study area

Alaska's 5 game management regions (Fig. 2.1) range widely in habitat types and human population densities. Region 1 (southeast Alaska) is dominated by coastal forests, wet meadows, and upland tundra. Winter temperatures in this region were the warmest of all regions from 2004 – 2013 (Table 2.1). This region also contained the second highest density of people among regions (Table 2.1). Region 2 (southcentral Alaska) includes a mix of coastal forests, upland tundra, and boreal forest. This region had the highest human population size and density, which is related to the presence of Anchorage, the largest city in Alaska (Table 2.1). Region 3 (interior Alaska) includes mainly boreal forest, with some upland tundra. Average winter temperatures in this region were the lowest among regions (Table 2.1). Region 4 (southcentral and southwest Alaska) is characterized mainly by boreal forest with interspersed upland tundra, and sections of lowland tundra. Average cumulative monthly snowfall for this region was greatest and the

human population was lowest compared to other regions (Table 2.1). Region 5 (northwestern Alaska) is dominated by upland and lowland tundra, with small areas of boreal forest. The Alaska Vegetation Classification provided vegetation descriptions of each region (Viereck et al. 1992).

Methods

Data sources

ADF&G data. ADF&G mailed the Alaska Trapper Questionnaire, a self-administered mail-back survey (hereafter "the questionnaire"), to trapping license holders in Alaska during the spring of most years since 1989 (Alaska Department of Fish and Game 2013). We acquired questionnaire data from 2004 – 2013, excluding 2010 when no survey was conducted, through a data sharing-agreement between the University of Alaska – Fairbanks and ADF&G (Appendix M and N). Data were also missing from Region 4 for 2004 – 2006. Questionnaires prior to 2004 were unavailable at the time of this study and therefore not included in our analyses. ADF&G mailed questionnaires between April and June during the survey period. We assumed respondents were a representative sample of trappers from each region. We also tested for differences in response rates among years to determine if there was a significant change between years. The questionnaire asked about trapping practices, effort, success, targeted species, the abundance of furbearers, trapline characteristics, trapping conditions, and questions pertaining to furbearer management in the state (Alaska Department of Fish and Game 2013). Information on effort included: total number of traps and snares set for the trapping season, length of trapline, and number of weeks trapped. Each year, the questionnaire requested trappers to provide harvest statistics for coyote (*Canis latrans*), wolf (*Canis lupus*), arctic fox (*Vulpes lagopus*), red fox (*Vulpes vulpes*), lynx (*Lynx canadensis*), beaver (*Castor canadensis*), muskrat (*Ondatra*

zibethicus), ermine (*Mustela erminea*), fisher (*Martes pennanti*), American and Pacific marten (*Martes americana, M caurina*), mink (*Neovision vision*), river otter (*Lontra canadensis*), wolverine (*Gulo gulo*), and red squirrel (*Tamiasciurus hudsonicus*).There were only two differences in species presence among regions: arctic fox were not present in Region 1 or 2, and fisher were only present in Region 1.

Fur value. We obtained fur values from Fur Harvesters Auction Incorporated (FHA) fur auctions (Fur Harvesters Auction Incorporated 2014). Average fur prices paid in mid-winter for arctic fox, beaver, coyote, red fox, lynx, American and Pacific marten, mink, ermine, muskrat, river otter, red squirrel, wolf, and wolverine were averaged each year to evaluate temporal changes in overall fur value. We used data for fur values from 2004 – 2013, excluding 2010 to match the Alaska Trapper Questionnaire data.

Weather. We obtained weather data from the National Oceanic and Atmospheric Administration's (NOAA) online data source, available from the National Climatic Data Center's (NCDC) website (National Climatic Data Center 2015). We chose ground-based weather stations to represent each region by selecting a minimum of 3 separate weather stations across each region (Appendix O). We chose stations from across the entire region to represent weather trends over time. Within each region, we averaged monthly temperatures and cumulative monthly snowfall among stations during winter for each year the survey was conducted. We defined winter as 1 September – 30 April because the "most important" trapping seasons for Alaskans (American marten, lynx, wolf, and beaver) fall within these dates (Schumacher 2013).

Fuel. We obtained region-specific data on fuel prices from the Alaska Department of Commerce (ADC) website (Alaska Department of Commerce 2015) and via e-mail correspondence with ADC. The average cost of regular unleaded gasoline in January from

communities in each region were used to estimate average annual fuel costs from 2004 – 2013, excluding 2010. We used the ADC prices from January to represent the price of fuel during the trapping season.

Roads and human population. We obtained data on the length of primary and secondary roads in each region from the Alaska Department of Natural Resources (2015) state geo-spatial data clearinghouse. Data were analyzed by region in ArcGIS version 10.1 (Environmental Systems Resources Institute, Redlands, CA). We obtained total population sizes and densities of people in each region from the United States Census Bureau (2010). Borough-level population statistics were summed according to game management regions.

Trapping effort and catch

We defined trapping effort as:

trapping effort = number of traps and snares set × length of trapline (km) × weeks trapped,

where traps set included all foothold, body gripping, and snare-like traps. Trapline length was the total length of the trapper's main trapline, and weeks trapped was the total number of weeks spent trapping over the entire trapping season. We suspect that unsuccessful trappers may not have reported catch data, however, we assumed this bias to be minimal. Data on trapping effort was not species-specific, and we therefore calculated the average effort per trapper by summing effort among all trappers in each region and dividing by the number of trappers in each region. Likewise, we calculated CPUE by dividing the total number of animals caught by the summed effort of all trappers in each region each year.

Statistical analyses

Questionnaire response rate bias. We used a Chi-squared test of independence to examine differences in response rates to the questionnaire among years. Since there were multiple years

tested, we used Cramer's V to determine the strength of the difference between years. We conducted all statistical analyses in the program R (R version 3.0.1, r-project.org, accessed 6 September 2013).

Effort vs. catch. We used linear regression to examine the relationship between effort and catch. Trappers were asked to report the total number of traps they set over the entire season in the ADF&G questionnaire. Therefore, we assumed that all traps reported by trappers were set and able to catch animals each week that was reported as actively trapped. We log-transformed effort data to meet the assumptions of normality.

Effects of external factors on trapping effort. To determine if external factors affected trapping effort, we ran a linear mixed-effects model using package "nlme" in the program R. We included fur value, fuel price, temperature, average cumulative monthly snowfall, human population, and cumulative road length as fixed effects, and year as a random effect in the model. We attempted to include region as a fixed effect, but we found that the model was over-fit and too complex for our dataset. We therefore explored the relationships between region, temperature, and effort using a linear regression model with region, temperature and their interaction as predictors, and log transformed effort as the response variable. We then examined the effect of region on effort after removing the influence of temperature, using a 1-way analysis of variance (ANOVA) with region as the predictor and the residuals of the temperature-on-effort regression as the response variable.

Differential trapping effort among regions. We used a one-way ANOVA followed by Tamhane's T2 post hoc tests (due to non-homogenous variances) to determine whether effort per trapper differed among regions. To further investigate regional differences, we used one-way ANOVA followed by Sheffé's post hoc tests and Tamhane's T2 post hoc tests to test for

differences in the number of animals caught, the number of traps set over the entire season, length of trapline (km), and number of weeks trapped per person. All analyses for this study were considered significant at $P < 0.05$.

Results

There were 5,538 ADF&G questionnaire responses in total for the sampling period. Response rates to the questionnaire among years varied between 22 - 32% ($\chi_8^2 = 119.9$, $P < 0.001$; Cramer's V = 0.077). Response rates within regions varied from 24 - 34% across years ($\chi_4^2 = 65.35$, $P < 0.001$; Cramer's V = 0.068). Average yearly harvest per trapper ranged from 25 – 39 furbearers (Table 2.2). Effort had a weak positive relationship with total catch of furbearers (Fig. 2.2; $R^2 = 0.12$, $F_{1,40} = 5.71$, $P = 0.022$).

Of the external factors examined in the mixed-effects model, temperature and cumulative road length were the only factors that significantly affected effort (Table 2.3). Contrary to expectations, higher temperatures reduced effort (Table 2.3; Fig. 2.3A). Fluctuations in average winter temperatures among regions and years explained 41% of the variation in effort ($F_{1,40} = 27.61$, $P < 0.001$; Fig. 2.3A). After controlling for the effect of temperature on effort, trapping effort still varied among the five game management units in Alaska (Fig. 2.3B). A multiple regression with temperature, region, and their interaction revealed that temperature did not influence effort within regions (ANOVA, temperature = $F_{1,32} = 51.63$, $P < 0.001$; region = $F_{4,32} = 9.92$, $P < 0.001$; temperature × region = $F_{4,32} = 0.79$, $P = 0.54$). Road length had a positive effect on trapping effort, while the human population did not influence trapping effort among regions (Table 2.3, Fig. 2.4).

Trapping effort differed by region (Table 2.2, ANOVA, $F_{4, 37} = 22.92$, $P < 0.001$). Region 3 had the highest effort per trapper (Tanhame's T2 post hoc tests: $P < 0.01$). Trapping effort remained

fairly consistent throughout the study period ($F_{1, 40} = 3.20$, $P = 0.081$). Similarly, the number of licensed trappers in Alaska did not change over time ($F_{1, 7} = 3.50$, $P = 0.10$), and average catch did not differ among years ($F_{1, 40} = 3.15$, $P = 0.084$). Region 3 had the highest number of traps, length of trapline (km), and total weeks trapped per person (Table 2.2).

Discussion

Use of CPUE to monitor furbearer populations has long been called for by researchers (e.g. Winterhalder 1980, Chilelli et al. 1996, Landriault et al. 2012). We found that trapping effort partially explained annual variation in total fur harvest, supporting the importance of accounting for effort. However, trapping effort explained only 12.5% of the variation in catch (Fig. 2.2). This finding is similar to a study conducted in Equatorial Guinea, where trapping effort explained 11% of catch for all bush-meat species (Rist 2007). In Guinea, hunters also used trapping as a method of obtaining game, and there was high variability between catch and effort due to time spent hunting, use of dogs, hunting group size, and other factors. The relatively weak relationship between effort and catch found in our study may be due to unmeasured factors such as trapper experience, catchability of furbearers, and method of transportation. Use of CPUE as an index of abundance for fisheries has been criticized for failing to control for the influence of similar confounding factors (e.g. Beverton and Holt 1957, Swain and Sinclair 1994, Gillis and Peterman 1998). Although we could not include these confounding factors in our study, simple measures of CPUE for furbearers could provide an improved index of abundance compared to raw harvest statistics, but the improvement may be modest.

Although we were unable to measure it, trapping experience may account for high variation in total catch among trappers within each year. Experienced trappers likely have a better understanding of where furbearers are located, which type of set works best, and other specific

skills that allow for less effort per catch compared to novices (Todd and Boggess 1987, Banci and Proulx 1999). The inclusion of covariates such as hunter skill and use of dogs in a bush-meat hunting system in Africa had little improvement (< 1%) in explaining variation in catch (Rist 2007). However, inclusion of covariates has proved useful in fisheries, where the inclusion 7 variables explained 26 – 40% of the variation in catch of walleye pollock (*Theragra chalcogramma*) (Battaile and Quinn 2004). We recommend including questions related to trapping skill (e.g. years of experience) on questionnaires to account for this potentially important source of variation.

As an additional refinement to a CPUE index, species-specific measures of effort may be better predictors of harvest than aggregated measures such as the one used in this study. Some species are harder to catch than others, which should affect CPUE. For example, wolves are more difficult to catch than muskrats and occur at lower densities. The effort needed to catch a wolf is much higher than what is needed to catch a muskrat, resulting in a higher CPUE for muskrats. Our study was unable to tease apart these differences because ADF&G questionnaires do not ask for effort data for each species individually. The inclusion of species-specific measures of CPUE increased the variation in catch that was explained by effort for various species of bush-meat animals in Equatorial Guinea (Rist 2007). To account for species-specific variation in CPUE, trapper questionnaires should request information about the number of traps and snares set for each species, along with catch per species. Although we acknowledge that some traps such as footholds can catch multiple species, others such as beaver sets are fairly species-specific.

We found that temperature was an important external factor affecting trapping effort.

We initially hypothesized that effort would increase with warmer temperatures, but our analyses revealed a negative effect of temperature on effort. Warmer temperatures promote more frequent

freeze-thaw cycles which can render traps inoperable, thus reducing the length of the trapping season, and influencing which traps can be set. In addition, travel is hindered with lack of snow and the inability to travel frozen lakes and rivers. Regions 1, 2, and 4 had warmer average temperatures than regions 3 and 5 (Table 2.1). These warm temperatures reduced the total length of the trapping season for these areas by an average of 22 days (Table 2.2), thereby reducing effort of trappers in these regions. Similarly, time spent hunting and trapping bush-meat was the most important predictor of catch in Equatorial Guinea (Rist 2007). Interestingly, effort was not significantly affected by annual temperature variation within region, indicating spatial variation in average temperatures was primarily responsible for our results. However, increasing temperatures due to climate change may reduce trapping effort across all regions in the future if warming trends continue (Cohen et al. 2012). A longer time series of data, or examination of finer-scale data such as daily or weekly variation in effort and temperature, would help to better resolve the relationship between temperature and trapping effort. These finer-scale measurements may become increasingly important as Arctic climates continue to warm (Cohen et al. 2012).

After removing the effect of temperature on effort across regions, a strong difference in effort among regions remained, indicating temperature was not the only factor explaining regional variation in trapping effort. These differences may be accounted for by differential road access and population densities among regions. Region 3 had the highest road access available to trappers among regions (Table 2.1), and regional variation in trapping effort closely mirrored the availability of roads (Fig. 2.4). Traveling to traplines by road allows trappers to access land farther away with ease and relative safety compared to travel through road-less terrain by foot, snowmobile, or all-terrain vehicle. Planes allow much greater access, but are expensive, and

require a special license to operate. In addition to increased road access, Region 3 likely had long traplines due to relative ease of creating a trapline in the large expanses of flat terrain found in interior Alaska compared to some of the more mountainous regions. Other studies have stated the importance of access to land for trapping effort (Banci and Proulx 1999, Zwick et al. 2002, Zwick et al. 2006), and the importance of land access via roads to hunters (Brinkman et al. 2007, Hiller et al. 2011, Landriault et al. 2012). Access is affected by several key variables including the availability of roads, trails, habitat, topography, and human population.

We predicted that human populations would negatively influence trapping effort, but to our surprise its affect was not significant. Region 2 showed the largest disparity in the ratio of population size and effort (Fig. 2.4), which is likely due to the presence of Anchorage. We believe this relationship was weak because of the locations of human populations among regions. Alaska has vast expanses of undeveloped land, with most people living in a few cities. The clustering of humans allows for more and longer traplines in undeveloped areas, compared to other states which have a more even distribution of people across the land.

Although we found weak differences in response rates to questionnaires among years and regions, we assumed questionnaires to be representative of Alaskan trappers. Data were not available on the total number of actual trappers in each region, for each year, because many trapping license holders do not necessarily trap. However, in Chapter 1 44% of trapping license holders in 2013 did not actually trap, meaning only 56% of license holders were trappers. Thus, even the lowest response rate in 2011 of 22% likely represented a large proportion of trappers. This response rate was considerably lower than other trapper questionnaire response rates which ranged from 63% - 74% for trappers from the northeastern United States (Siemer et al. 1994, Daigle et al. 1998, Zwick et al. 2006). However, these studies used the Total Design Method

(Dillman 1978) (a multiple mailing method) to attain higher response rates, compared to the single mailing of the Alaska Trapper Questionnaire. With a multiple mail design such as Dillman's, response rates in Alaska varied from 19% - 38% (Chapter 1, Fix et al. 2009). The regional differences in response rate, along with only using a single mailing may explain why response rates were lower for the Alaska Trapper Questionnaire.

Although we found that fuel and fur prices did not significantly affect effort, a major decrease in costs associated with trapping or a several-fold increase in fur prices, could entice inactive trappers or non-trappers to start trapping (McDonald and Harris 1999, Gosselink et al. 2003, Brinkman et al. 2014). In this study, gas ranged from $2.74 - $6.64 across all regions and years, and average fur values ranged from $71.63 - $105.40 across years. Changes in fuel price or fur value beyond what we observed in our study could influence overall trapping effort and possibly change individual CPUE. We recommend that future studies explore how different scales of changes in these variables influence trapping effort.

Management implications

We recommend that furbearer managers incorporate effort as an adjustment to abundance indices based on raw harvest data. Species-specific measures of effort and catch should be recorded annually to refine CPUE as an index of abundance. Similarly, incorporating covariates related to a trapper's skill, methods of trapping, transportation on the trapline, and catchability of furbearers may improve the amount of variation in catch that is explained by effort. These measures could improve our understanding of how and why furbearer abundances fluctuate. Managers can expect less trapping effort in regions with warmer winters, but annual variation in temperature within regions appears to have only modest effects on trapping effort. Effort is expected to be highest in areas with plentiful road access. When new roads are constructed in

areas open to fur trapping, managers should expect increases in trapping effort. Trapping effort is likely influenced by many factors that are region specific. Managers should contact and work with local trappers to determine which factors are important in the area they manage.

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Literature cited

Alaska Department of Commerce. 2015. Current community conditions: Fuel prices across Alaska. Division of Community and Regional Affairs.

Alaska Department of Fish and Game. 2013. Alaska trapper questionnaire. Juneau, Alaska, USA. < http://www.adfg.alaska.gov/index.cfm?adfg=trapping.reports>. Accessed 20 November 2014.

_____. 2014. 2013-2014 Alaska trapping regulations. Juneau, Alaska, USA. < http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulaitions.trapping>. Accessed 23 November 2014.

_____. 2015. License statistics. The Alaska Department of Fish and Game, Juneau, AK, USA. < http://www.adfg.alaska.gov/index.cfm?adfg=licensevendors.statistics>. Accessed 30 January 2015.

Alaska Department of Natural Resources. 2015. Alaska state geo-spatial data clearinghouse. Anchorage, AK, USA. < http://www.asgdc.state.ak.us/>. Accessed 15 March 2015.

Andersen, D. B. 1993. Trapping in Alaska and the European Economic Community import ban on furs taken with leghold traps. Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska, USA.

Armstrong, J. B., and A. N. Rossi. 2000. Status of avocational trapping based on the perspectives of state furbearer biologists. Wildlife Society Bulletin 28:825-832.

Banci, V., and G. Proulx. 1999. Resiliency of furbearers to trapping in Canada. Alpha Wildlife Research & Management, Sherwood Park, Alta:175-204.

Battaile, B. C., and T. J. Quinn. 2004. Catch per unit effort standardization of the eastern Bering Sea walleye pollock (*Theragra chalcogramma*) fleet. Fisheries Research 70:161-177.

Beverton, R., and S. Holt. 1957. On the dynamics of exploited fish populations. Ministry of Agriculture, London, England, UK.

Brinkman, T., K. B. Maracle, J. Kelly, M. Vandyke, A. Firmin, and A. Springsteen. 2014. Impact of fuel costs on high-latitude subsistence activities Ecology and Society 19:18.

Brinkman, T. J., G. P. Kofinas, F. S. Chapin III, and D. K. Person. 2007. Influence of hunter adaptability on resilience of subsistence hunting systems. Journal of Ecological Anthropology 11:58-63.

Brodie, J. F., and E. Post. 2010. Nonlinear responses of wolverine populations to declining winter snowpack. Population ecology 52:279-287.

Chilelli, M., B. Griffith, and D. J. Harrison. 1996. Interstate comparisons of river otter harvest data. Wildlife Society Bulletin:238-246.

Cohen, J. L., J. C. Furtado, M. A. Barlow, V. A. Alexeev, and J. E. Cherry. 2012. Arctic warming, increasing snow cover and widespread boreal winter cooling. Environmental Research Letters 7:014007.

Daigle, J. J., R. M. Muth, R. R. Zwick, and R. J. Glass. 1998. Sociocultural dimensions of trapping: A factor analytic study of trappers in six northeastern states. Wildlife Society Bulletin:614-625.

DeVink, J.-M., D. Berezanski, and D. Imrie. 2011. Comments on Brodie and Post: harvest effort: The missing covariate in analyses of furbearer harvest data. Population ecology 53:261-262.

Dillman, D. A. 1978. Mail and telephone surveys: The total design method. John Wiley and Sons, New York, New York, USA.

Fix, P. J., L. E. Kruger, D. W. McCollum, S. J. Alexander, L. Dalle-Molle, W. Overbaugh, and J. J. Brooks. 2009. Understanding Alaska Public Lands Visitors Through Collaboration: The Alaska Residents Statistics Program. Alaska Park Science 8.

Fur Harvesters Auction Incorporated. 2014. Auction Results. North Bay, Onatiro, CA. < http://furharvesters.com/auctionresults.html>. Accessed 12 January 2015.

Gese, E. M. 2001. Monitoring of terrestrial carnivore populations. National Wildlife Research Center, Fort Collins, Colorado, USA.

Gillis, D., and R. Peterman. 1998. Implications of interference among fishing vessels and the ideal free distribution to the interpretation of CPUE. Canadian Journal of Fisheries and Aquatic Sciences 55:37-46.

Gosselink, T. E., T. R. Van Deelen, R. E. Warner, and M. G. Joselyn. 2003. Temporal habitat partitioning and spatial use of coyotes and red foxes in east-central Illinois. The Journal of Wildlife Management:90-103.

Haire, A. R., and R. B. Machemehl. 2007. Impact of rising fuel prices on US transit ridership. Transportation Research Record: Journal of the Transportation Research Board 1992:11-19.

Harley, S. J., R. A. Myers, and A. Dunn. 2001. Is catch-per-unit-effort proportional to abundance? Canadian Journal of Fisheries and Aquatic Sciences 58:1760-1772.

Hiller, T. L., D. R. Etter, J. L. Belant, and A. J. Tyre. 2011. Factors affecting harvests of fishers and American martens in northern michigan. The Journal of Wildlife Management 75:1399-1405.

Kapfer, P. M., and K. B. Potts. 2012. Socioeconomic and ecological correlates of bobcat harvest in Minnesota. The Journal of Wildlife Management 76:237-242.

Landriault, L. J., B. J. Naylor, S. C. Mills, and J. A. Baker. 2012. Evaluating the relationship between trapper harvest of American martens (*Martes americana*) and the quantity and spatial configuration of habitat in the boreal forests of Ontario, Canada. The Forestry Chronicle 88:317-327.

McDonald, R. A., and S. Harris. 1999. The use of trapping records to monitor populations of stoats *Mustela erminea* and weasels *M nivalis*: The importance of trapping effort. Journal of Applied Ecology 36:679-688.

Minnesota Department of Natural Resources. 2014. Minnesota Hunting/Trapping Regulations. St. Paul, MN. < http://dnr.state.mn.us/regulations/hunting/index.html>. Accessed 13 March 2015.

National Climatic Data Center. 2015. National Climatic Data Center. National Oceanic and Atmospheric Administration, Asheville, North Carolina. < http://www.ncdc.noaa.gov/>. Accessed Janurary 5 2015.

Poole, K., and G. Mowat. 2001. Alberta furbearer harvest data analysis. Report 31.

Rist, J. 2007. Bushmeat catch per unit effort in space and time: a monitoring tool for bushmeat hunting. Dissertation, Imperial College, London, England, UK.

Royama, T. 1992. Analytical population dynamics. Volume 10.Springer, London, England, UK.

Schumacher, T. 2013. Alaska trapper questionnaire report. Alaska Department of Fish and Game, Division of Wildlife Conservation. Juneau, Alaska, USA.

Schwanke, A. R., and M. Burch. 2010. Furbearer management report of survey-inventory activities.

Siemer, W. F., G. R. Batcheller, R. J. Glass, and T. L. Brown. 1994. Characteristics of trappers and trapping participation in New York. Wildlife Society Bulletin 22:100-111.

Stabler, J. C., G. Tolley, and E. C. Howe. 1990. Fur trappers in the Northwest Territories: An econometric analysis of the factors influencing participation. Arctic:1-8.

Swain, D., and A. Sinclair. 1994. Fish distribution and catchability: What is the appropriate measure of distribution? Canadian Journal of Fisheries and Aquatic Sciences 51:1046-1054.

Todd, A. W., and E. K. Boggess. 1987. Characteristics, activities, lifestyles, and attitudes of trappers in North America. Pages 59-76 *in* M. Novak, editor. Wild Furbearer Management and Conservation in North America. Ontario Trappers Association, Ontario, CA.

United States Census Bureau. 2010. State and county QuickFacts. United States Census Bureau, Washington, DC, USA. < http://quickfacts.census.gov/qfd/index.html>. Accessed 12 March 2015.

Vantassel, S. M., T. L. Hiller, K. D. Powell, and S. E. Hygnstrom. 2010. Using Advancements in cable-trapping to overcome barriers to urbearer management in the United States. The Journal of Wildlife Management 74:934-939.

Viereck, L. A., C. Dyrness, A. Batten, and K. Wenzlick. 1992. The Alaska vegetation classification. Pacific Northwest Research Station, Portland, Oregon, USA.

Wilson, D. E., F. R. Cole, J. D. Nichols, R. Rudran, and M. S. Foster. 1996. Measuring and monitoring biological diversity: Standard methods for mammals. Volume 409.Smithsonian Institution Press Washington, DC, USA.

Winterhalder, B. P. 1980. Canadian fur bearer cycles and Cree-Ojibwa hunting and trapping practices. American Naturalist:870-879.

Yom-Tov, Y., S. Yom-Tov, D. MacDonald, and E. Yom-Tov. 2007. Population cycles and changes in body size of the lynx in Alaska. Oecologia 152:239-244.

Zwick, R. R., R. J. Glass, K. Royar, and T. Decker. 2002. Sociocultural perspectives of trapping revisited: A comparative analysis of activities and motives 1994 and 2000.118-123.

Zwick, R. R., B. Muth, and D. Solan. 2006. A longitudinal comparison of activities and motives of Vermont trappers: 1994, 2000, and 2005. 2006.

Tables

Table 2.1. A description of game management regions 1 - 5 of the Alaska Department of Fish and Game, Alaska, USA (ADF&G 2015). Winter is defined here as 1 September – 30 April to coincide with trapping seasons from 2004-2013[1]. Temperature was defined as the average (± SE) winter temperature. Snowfall was defined as the average (± SE) cumulative snowfall during the winter. Fuel (± SE) was represented by the price of a gallon of regular conventional gasoline in January. The average yearly fur value (± SE) was the combined average January auction price of all furbearers, which did not vary by region. Lowest elevations for each region are sea-level. Human populations were based on the 2010 United States Census (United States Census Bureau 2010). Climate data were provided by the National Climatic Data Center 2015. Alaska road data were provided by Alaska Department of Natural Resources (Alaska Department of Natural Resources 2010).

Management region	1	2	3	4	5
Area (km^2)	95,000	66,000	636,000	286,000	421,000
Population	71664	459,449	112,024	16,177	50,917
Population density (people/km^2)	0.75	6.96	0.18	0.06	0.12
Max elevation (m)	5,489	4,016	6,194	4,317	2,370
Temperature (°C)	3.17 ±0.19	2.14 ±1.28	-11.86 ±0.25	-3.63 ±0.23	-11.58 ±0.43
Snowfall (cm)	26.8 ±4.2	30.6 ±4.0	25.6 ±1.6	37.0 ±2.4	22.2 ±2.4
Fuel cost (regular)	3.99 ±0.23	3.97 ±0.28	5.08 ±0.31	4.78 ±0.28	5.47 ±0.40
Fur value	87.52 ±4.40	87.52 ±4.40	87.52 ±4.40	87.52 ±4.40	87.52 ±4.40
Total length of roads (km)	8,700	5,611	20,153	8,530	9,205
Road density (km/km^2)	0.092	0.085	0.032	0.030	0.022

[1]No survey was conducted in 2010.

Table 2.2. The mean (± SE) total yearly catch of all furbearing species per trapper , number of traps set over the entire trapping season, trapline length (km), number of weeks spent trapping per person, and trapping effort (number of traps set × trapline length (km) × weeks trapped) per person for Alaskan trappers from 2004 - 2013[1] in game management regions 1 - 5 in Alaska, USA. An analysis of variance (ANOVA) with Scheffé's and Tamhane's T2 post hoc tests was used to find differences among regions. Unique superscripts (^{abcd}) represent significant differences at the $P < 0.05$ level.

Region	1	2	3	4	5
Catch	34.6^{a} ±3.3	27.3^{a} ±4.5	38.8^{a} ±4.0	24.9^{a} ±2.6	37.3^{a} ±5.1
Traps	40.8^{a} ±2.4	40.0^{a} ±2.6	72.5^{b} ±5.2	33.7^{a} ±3.3	37.1^{a} ±3.2
Length of trapline (km)	32.9^{a} ±2.1	35.6^{ab} ±2.7	59.9^{c} ±3.0	50.0^{bc} ±6.4	51.9^{c} ±3.6
Weeks spent trapping	7.6^{a} ±0.2	10.2^{b} ±0.1	12.4^{c} ±0.2	8.9^{a} ±0.3	11.8^{bc} ±0.5
Effort	4.0^{a} ±0.1	4.1^{a} ±0.1	4.7^{b} ±0.1	2.8^{a} ±0.7	4.3^{a} ±0.1

[1]No survey conducted in 2010.

Table 2.3. Effect of external factors on trapping effort in Alaska, USA. Results of a mixed-effects model are shown, with year as a random effect, average January fuel price (price of a gallon of regular conventional gas), average winter temperature (°C), average winter snow fall (cm), average yearly fur value (combined average January auction price of all furbearers), cumulative road length (km), and population density (people/square kilometer) as fixed effects, and average trapping effort (number of traps set × trapline length (km) × weeks trapped) per person as the response variable. Numerator and denominator degrees of freedom (*df*), F-values (*F*), and P-values (*P*) for fixed effects are shown. Fur value had a lower denominator *df* than other factors because this factor varied only among years and not among regions.

External factor	*df*	*F*	*P*
(Intercept)	1, 28	18,628.69	≤ 0.001
Temperature °C	1, 28	64.81	≤ 0.001
Roads (km)	1, 28	25.33	≤ 0.001
Fur value	1, 7	4.87	0.063
Population	1, 28	2.56	0.121
Cumulative snowfall (cm)	1, 28	1.63	0.213
Fuel	1, 28	0.92	0.347

Figures

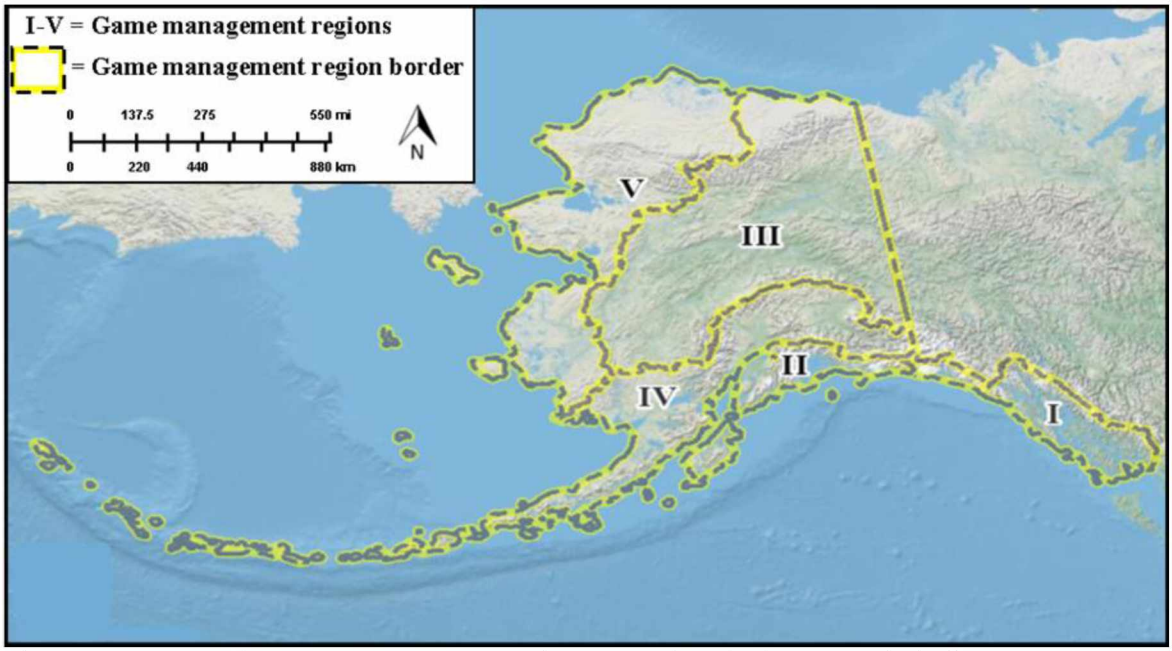

Figure 2.1. Map of game management regions 1 - 5 in Alaska, USA (Alaska Department of Fish and Game 2014).

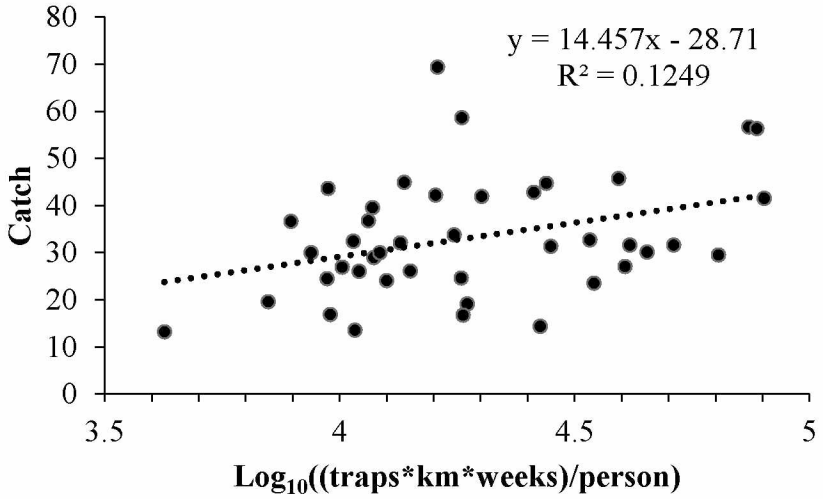

Figure 2.2. Effect of trapping effort on furbearer harvest in Alaska, USA, 2004 – 2013 (excluding 2010 when no survey was conducted). Data were obtained from the Alaska Trapper Questionnaire, supplied by the Alaska Department of Fish and Game (n = 5,538 respondents). Trapping effort was measured as the average number of traps and snares set × trapline length (km) × weeks trapped per person in each game management region (Fig. 2.1), and total catch was the number of all furbearers caught per person per year in each region. Each data point represents the average catch and effort in each region each year (n = 45).

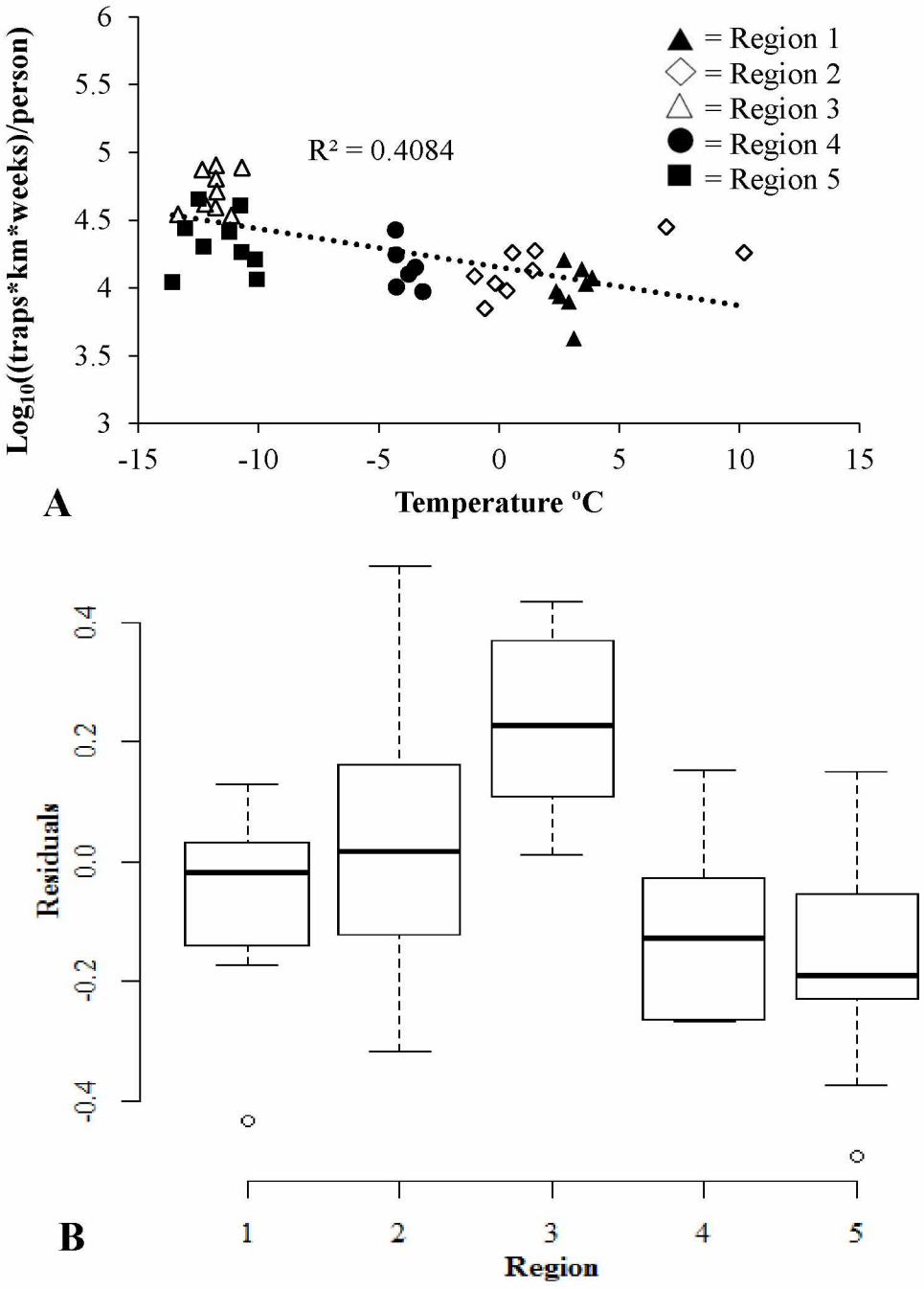

Figure 2.3. A. Effect of winter temperature on trapping effort from 2004 – 2013 (excluding 2010 when no survey was conducted) in Alaska, USA. Data were obtained from the Alaska Trapper Questionnaire, supplied by the Alaska Department of Fish and Game (n = 5,538 respondents). Region 1 is represented by solid triangles, Region 2 is open diamonds, Region 3 is open

Figure 2.3 continued...

triangles, Region 4 is solid circles, and Region 5 is solid squares. Effort was measured as the average number of traps and snares set × trapline length (km) × weeks trapped per person in each game management region (Fig. 2.1), and winter (1 September – 30 April) temperature (°C) was averaged among three weather stations in each region each year. B. Regional differences in trapping effort after controlling for the effect of temperature. A boxplot of the residuals from the regression in panel A across regions is shown. Central horizontal lines show means, boxes show 25^{th} and 75^{th} quartiles, and whiskers show 95% CIs.

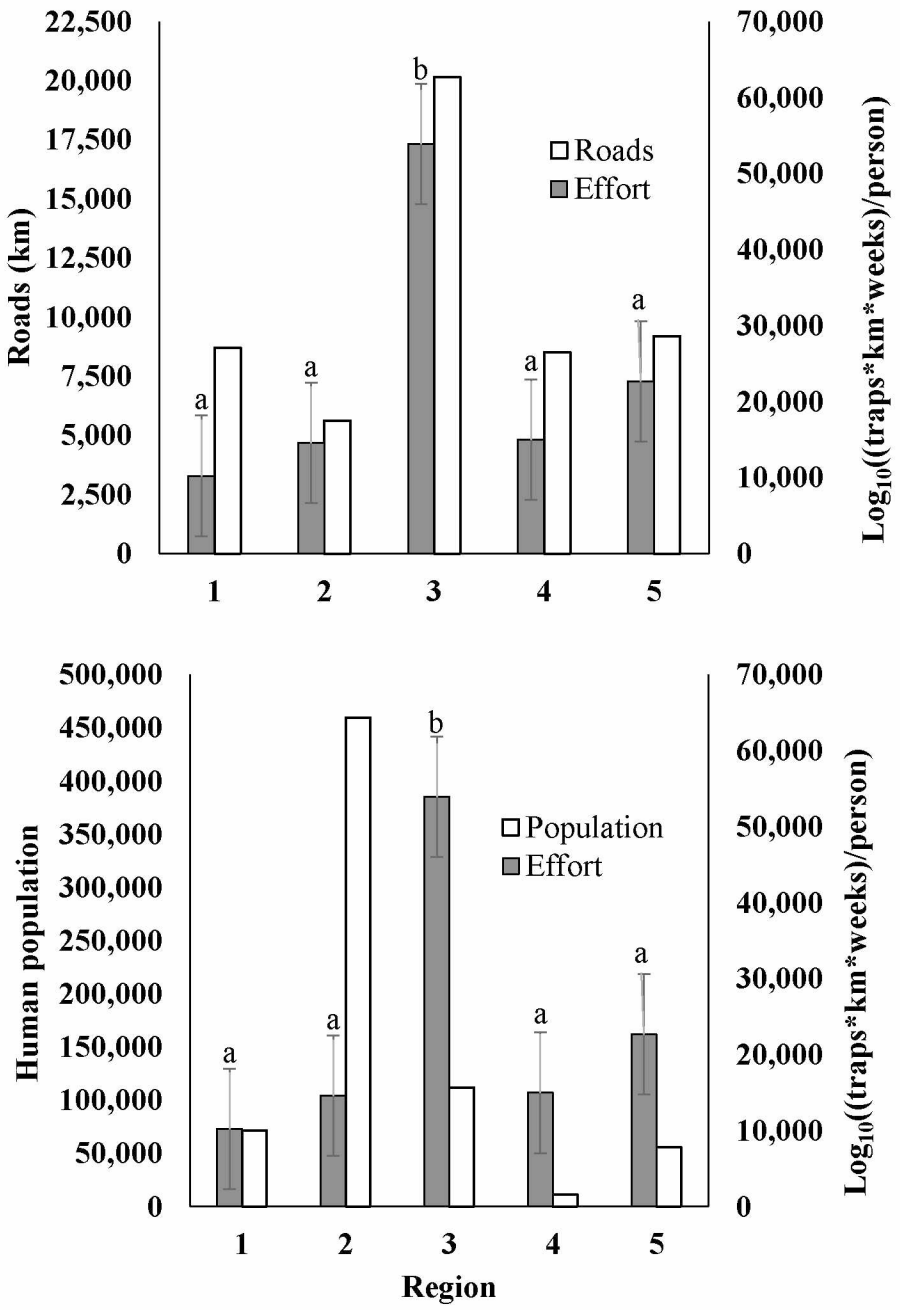

Figure 2.4. Regional variation in trapping effort in relation to (A) road availability and (B) human population (B) from 2004 – 2013 (excluding 2010 when no survey was conducted) in Alaska, USA. Data were obtained from the Alaska Trapper Questionnaire, supplied by the Alaska Department of Fish and Game (n = 5,538 respondents). Mean (±SE) trapping effort

Figure 2.4 continued...

(number of traps and snares set × trapline length (km) × weeks trapped) per person (grey bars), mean total length (km) of all roads (open bars, A) and total human population size (open bars, B) in game management regions 1 - 5 (Fig. 2.1) are shown. Unique letters above bars (e.g., a, b) represent significant differences at the $P < 0.05$ level for effort.

Conclusions

Motivations, external factors, and social issues differentially influence trapping effort. The most important external factor and social issue that influenced trapping effort were furbearer populations and access to land. I found that these issues influenced trapping effort similarly among groups, but motivations were the strongest predictor of trapping effort. These internal drivers of trapping effort may explain in part why effort did not have a strong relationship with catch.

My study provides evidence that adjusting abundance indices based on harvest with effort may be important in Alaska. Other studies suggest the importance of this adjustment for furbearer harvest (Chilelli, Griffith, & Harrison, 1996; Poole & Mowat, 2001; Wilson, Cole, Nichols, Rudran, & Foster, 1996), while some studies have illustrated its importance (Rist, 2007). My findings suggest that a weak relationship exists, but the strength of the relationship may increase if new variables are added, which is similar to what fisheries researchers deem "standardization". Future studies should include covariates such as trapping skill, furbearer catchability, trapline transportation, and methods of take (Harley, Myers, & Dunn, 2001; Schumacher, 2013) to account for variation in effort among trappers.

External factors should be tracked to understand how trappers' effort responds to changes over long periods of time. Managers can expect warming temperatures to limit trapping effort due to increased melt-freeze cycles which can hinder trap function. Also, low snowfall and open water can make travel difficult by snowmobile, which may reduce trapping effort. Weather can physically inhibit trapping, but fur values appear to have a weak influence on effort. These results conflict with findings from older studies (Daigle, Muth, Zwick, & Glass, 1998; Gosselink, Van Deelen, Warner, & Joselyn, 2003) but are consistent with findings from newer studies

(Fortin & Cantin, 2005; Hiller, Etter, Belant, & Tyre, 2011; Kapfer & Potts, 2012), suggesting a shift in motivations from economic to recreational. Researchers should determine how substantial a rise in fur values is needed to increase participation and therefore affect overall effort. Researchers should continue surveying trappers to determine which external factors affect them, as changes in economics, climate, and culture have the potential to influence trapping effort.

Managers are capable of influencing the effect of social issues on trapping effort. Both access to land and human conflict were prominent issues for trappers in Alaska. Furbearer managers may be able to partially combat these issues through mandatory trapper education programs. Novice trappers can be educated in the unwritten "rules" of trapping in Alaska and guide them in procedures to establish a trapline, while respecting others' lines. Programs should be created through a joint effort between local trapping organizations, state agencies, native entities, and federal agencies to maximize the depth and breadth of knowledge.

Trappers provide data on trends in furbearer abundances, trends in other species, motivations of trappers, the influence of external factors, and social issues on trapping effort. Mailed questionnaires can cover large areas and managers can gain substantial amounts of information in a relatively short amount of time. Annual questionnaires should ask questions about demographics, trapline characteristics and logistics, catch and effort, and trapper skill. Questions regarding the influence of external factors, social issues, and motivations should be included in questionnaires periodically so managers can adjust their management decisions based on changes to these variables. Distribution of questionnaires should follow the Dillman Total Design (Dillman, 2011), if funding allows, to maximize response rates. Information on catch and effort can guide managers to locations that may require more costly or labor intensive methods

for population estimates. Information that the trapping public can provide to researchers through citizen science can come full circle to benefit all members of society.

References

Chilelli, M., Griffith, B., & Harrison, D. J. (1996). Interstate comparisons of river otter harvest data. *Wildlife Society Bulletin*, 238-246.

Daigle, J. J., Muth, R. M., Zwick, R. R., & Glass, R. J. (1998). Sociocultural dimensions of trapping: A factor analytic study of trappers in six northeastern states. *Wildlife Society Bulletin*, 614-625.

Dillman, D. A. (2011). *Mail and Internet surveys: The tailored design method--2007 Update with new Internet, visual, and mixed-mode guide*. Hoboken, New Jersey, USA: John Wiley & Sons.

Fortin, C., & Cantin, M. (2005). Harvest status, reproduction and mortality in a population of American martens in Quebec, Canada *Martens and Fishers (Martes) in Human-Altered Environments* (pp. 221-234): Springer.

Gosselink, T. E., Van Deelen, T. R., Warner, R. E., & Joselyn, M. G. (2003). Temporal habitat partitioning and spatial use of coyotes and red foxes in east-central Illinois. *The Journal of Wildlife Management*, 90-103.

Harley, S. J., Myers, R. A., & Dunn, A. (2001). Is catch-per-unit-effort proportional to abundance? *Canadian Journal of Fisheries and Aquatic Sciences, 58*(9), 1760-1772.

Hiller, T. L., Etter, D. R., Belant, J. L., & Tyre, A. J. (2011). Factors affecting harvests of fishers and American martens in northern michigan. *The Journal of Wildlife Management, 75*(6), 1399-1405.

Kapfer, P. M., & Potts, K. B. (2012). Socioeconomic and ecological correlates of bobcat harvest in Minnesota. *The Journal of Wildlife Management, 76*(2), 237-242.

Poole, K., & Mowat, G. (2001). Alberta furbearer harvest data analysis (Sustainable Resource Development Fish and Wildlife Division, Trans.) *Alberta Species at Risk Report* (pp. 51). Edmonton, Alberta, CA.

Rist, J. (2007). *Bushmeat catch per unit effort in space and time: a monitoring tool for bushmeat hunting.* (Doctoral dissertation), Imperial College, London, England, UK.

Schumacher, T. (2013). Trapper Questionnaire. Juneau, Alaska, USA: Alaska Department of Fish and Game.

Wilson, D. E., Cole, F. R., Nichols, J. D., Rudran, R., & Foster, M. S. (1996). *Measuring and monitoring biological diversity: Standard methods for mammals* (Vol. 409). Washington, DC, USA: Smithsonian Institution Press

Appendices

Appendix A: Questionnaire on motivations of interior Alaskan trappers

QUESTIONNAIRE ON MOTIVATIONS OF INTERIOR ALASKAN TRAPPERS

Photo courtesy of Alex Tirabasso, © Canadian Museum of Nature

STOP:

If you have never trapped before please check "No" and send the questionnaire back blank. If you have trapped in the past, check "Yes" and continue filling out the questionnaire.

Yes___ No___.

Please return the completed questionnaire in the envelope provided

University of Alaska – Fairbanks
Ross Dorendorf
Department of Biology and Wildlife
PO BOX 756100
Fairbanks, AK 99775 - 6100

I. CURRENT TRAPPING ISSUES

Directions: Please circle the number that best represents how much you agree or disagree with the following statements.

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
There are enough new trappers to replace old trappers	1	2	3	4	5	6	7
Not enough trappers are teaching new generations how to trap	1	2	3	4	5	6	7
The public sees trapping as humane	1	2	3	4	5	6	7
The public has an overall positive image of trapping	1	2	3	4	5	6	7
There are more trappers in Alaska now than there used to be	1	2	3	4	5	6	7
Conflicts between trappers prevent people from trapping	1	2	3	4	5	6	7
Conflicts between trappers are happening more than they used to	1	2	3	4	5	6	7
Conflicts between trappers have led people to change their trapline	1	2	3	4	5	6	7
The number of pets caught in traps has been increasing in recent years	1	2	3	4	5	6	7
The number of incidents of people disturbing traps has been increasing	1	2	3	4	5	6	7
Recreational users limit where people can trap	1	2	3	4	5	6	7
The most frequent conflicts trappers have are with recreationalists	1	2	3	4	5	6	7
The most frequent conflicts trappers have are with other trappers	1	2	3	4	5	6	7

Furbearers being stolen out of traps has been increasing in recent years	1	2	3	4	5	6	7
The number of traps being stolen has been increasing in recent years	1	2	3	4	5	6	7
Trapping seasons need to be longer than they currently are	1	2	3	4	5	6	7
Trapping seasons need to be shorter than they currently are	1	2	3	4	5	6	7

Statement	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
Current trapping regulations are too strict	1	2	3	4	5	6	7
Furbearer populations are too low in Interior of Alaska	1	2	3	4	5	6	7
It is difficult to find a place to trap	1	2	3	4	5	6	7
More federal land needs to be opened up to trapping	1	2	3	4	5	6	7
More state land needs to be opened up to trapping	1	2	3	4	5	6	7

II. REASONS FOR TRAPPING

Directions: Please circle the number that best represents how much you agree or disagree with the following reasons for why you trap.

Reasons for trapping	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
Enjoy nature	1	2	3	4	5	6	7
Observe wildlife	1	2	3	4	5	6	7
Learn about wildlife	1	2	3	4	5	6	7
Feel like I am a part of nature	1	2	3	4	5	6	7
Staying in shape	1	2	3	4	5	6	7

Getting exercise	1	2	3	4	5	6	7
Getting a chance to spend time alone	1	2	3	4	5	6	7
For a change of routine	1	2	3	4	5	6	7
Time to think	1	2	3	4	5	6	7
Getting away from everyday problems	1	2	3	4	5	6	7
Feel a sense of accomplishment	1	2	3	4	5	6	7

Reasons for trapping	Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither	Slightly Agree	Moderately Agree	Strongly Agree
Being self-sufficient	1	2	3	4	5	6	7
Test my skills and abilities	1	2	3	4	5	6	7
Do something challenging	1	2	3	4	5	6	7
Help manage furbearer populations	1	2	3	4	5	6	7
Use furbearers for food	1	2	3	4	5	6	7
Use furbearers to make clothes	1	2	3	4	5	6	7
Use fur for crafts or ceremonies	1	2	3	4	5	6	7
Predator control	1	2	3	4	5	6	7
Nuisance wildlife control	1	2	3	4	5	6	7
Competing with others	1	2	3	4	5	6	7
Spend time with family and friends	1	2	3	4	5	6	7
Teach others to trap	1	2	3	4	5	6	7

For a little extra spending money	1	2	3	4	5	6	7
To supplement family income	1	2	3	4	5	6	7
Provide main source of income	1	2	3	4	5	6	7
Participate in favorite activity	1	2	3	4	5	6	7
Important part of lifestyle	1	2	3	4	5	6	7
Maintain tradition	1	2	3	4	5	6	7
Remain in touch with heritage	1	2	3	4	5	6	7

III. CHANGES IN TRAPPING EFFORT

Directions: Please circle the number that best represents how much your trapping effort would increase or decrease compared to the normal amount of effort you put into trapping.

Reasons for changing trapping effort	Significantly Decrease	Moderately Decrease	Slightly Decrease	Neither	Slightly Increase	Moderately Increase	Significantly Increase
Fur prices that are higher than current prices	1	2	3	4	5	6	7
Fur prices that are lower than current prices	1	2	3	4	5	6	7
Trapping gear becomes more expensive than it is now	1	2	3	4	5	6	7
Trapping gear becomes less expensive than it is now	1	2	3	4	5	6	7
Fuel becomes more expensive than it is now	1	2	3	4	5	6	7
Fuel becomes less expensive than it is now	1	2	3	4	5	6	7
The price of a resident trapping license becomes more expensive	1	2	3	4	5	6	7
The price of a resident trapping	1	2	3	4	5	6	7

license becomes less expensive							
Snow depth of 0 to 6 inches	1	2	3	4	5	6	7
Snow depth of 6 to 12 inches	1	2	3	4	5	6	7
Snow depth of 12 to 18 inches	1	2	3	4	5	6	7
Temperatures ranging from -40° to -20° Fahrenheit	1	2	3	4	5	6	7
Temperatures ranging from -20° to 0° Fahrenheit	1	2	3	4	5	6	7
Temperatures ranging from 0° to 20° Fahrenheit	1	2	3	4	5	6	7
Early season melting and freezing cycles	1	2	3	4	5	6	7
Furbearer populations that are higher than current populations	1	2	3	4	5	6	7
Furbearer populations that are lower than current populations	1	2	3	4	5	6	7
Catching non-target animals	1	2	3	4	5	6	7
If other trappers are present in the area I trap	1	2	3	4	5	6	7
Pets getting caught in traps	1	2	3	4	5	6	7
Reasons for changing trapping effort	Significantly Decrease	Moderately Decrease	Slightly Decrease	Neither	Slightly Increase	Moderately Increase	Significantly Increase
If there are recreationalists in the area I trap	1	2	3	4	5	6	7
Poor health	1	2	3	4	5	6	7
Family commitments	1	2	3	4	5	6	7
Having free time	1	2	3	4	5	6	7

Difficult fur handling (skinning, fleshing, stretching)	1	2	3	4	5	6	7
Easy fur handling (skinning, fleshing, stretching)	1	2	3	4	5	6	7
Animals that are difficult to catch	1	2	3	4	5	6	7
Animals that are easy catch	1	2	3	4	5	6	7
Having to perform trail maintenance	1	2	3	4	5	6	7

1. **What is the minimum depth of snow that must be on the ground for you to trap? (Choose one)**

____0-6 inches ____12-18 inches ____There is no minimum snow depth for me to trap

____6-12 inches ____More than18 inches

2. **What is the lowest temperature at which you will still trap? (Choose one)**

____0º to -10º F ____-21º to -30º F ____Other _____(Please specify)

____-11º to -20º F ____-31º to -40º F ____I trap no matter how low the temperature is

Please circle the number that best represents how difficult or not difficult fur handling (skinning, fleshing, and stretching) is for each species. Only answer for species you trap for.

Species	Not at all Difficult			Somewhat Difficult			Extremely Difficult
Beaver	1	2	3	4	5	6	7
Coyote	1	2	3	4	5	6	7
Arctic Fox	1	2	3	4	5	6	7
Red Fox	1	2	3	4	5	6	7
Lynx	1	2	3	4	5	6	7
Marten	1	2	3	4	5	6	7
Mink	1	2	3	4	5	6	7
Ermine or Least Weasel	1	2	3	4	5	6	7
Muskrat	1	2	3	4	5	6	7
River Otter	1	2	3	4	5	6	7

Red Squirrel	1	2	3	4	5	6	7
Wolf	1	2	3	4	5	6	7
Wolverine	1	2	3	4	5	6	7

Species	Not at all Difficult			Somewhat Difficult			Extremely Difficult
Beaver	1	2	3	4	5	6	7
Coyote	1	2	3	4	5	6	7
Arctic Fox	1	2	3	4	5	6	7
Red Fox	1	2	3	4	5	6	7
Lynx	1	2	3	4	5	6	7
Marten	1	2	3	4	5	6	7
Mink	1	2	3	4	5	6	7
Ermine or Least Weasel	1	2	3	4	5	6	7
Muskrat	1	2	3	4	5	6	7
River Otter	1	2	3	4	5	6	7
Red Squirrel	1	2	3	4	5	6	7
Wolf	1	2	3	4	5	6	7
Wolverine	1	2	3	4	5	6	7

Please circle the number that best represents how difficult or not difficult it is to catch species you trap for. Only answer for species you trap for.

Species	Not at all Difficult			Somewhat Difficult			Extremely Difficult
Beaver	1	2	3	4	5	6	7
Coyote	1	2	3	4	5	6	7
Arctic Fox	1	2	3	4	5	6	7
Red Fox	1	2	3	4	5	6	7
Lynx	1	2	3	4	5	6	7
Marten	1	2	3	4	5	6	7
Mink	1	2	3	4	5	6	7
Ermine or Least Weasel	1	2	3	4	5	6	7

Muskrat	1	2	3	4	5	6	7
River Otter	1	2	3	4	5	6	7
Red Squirrel	1	2	3	4	5	6	7
Wolf	1	2	3	4	5	6	7
Wolverine	1	2	3	4	5	6	7

3. For each visit to your trapline, how many hours do you usually spend on trail maintenance?

_____Hours

Reasons for changing trapping effort	Significantly Decrease	Moderately Decrease	Slightly Decrease	Neither	Slightly Increase	Moderately Increase	Significantly Increase
Fur prices that are higher than current prices	1	2	3	4	5	6	7
Fur prices that are lower than current prices	1	2	3	4	5	6	7
Trapping gear becomes more expensive than it is now	1	2	3	4	5	6	7
Trapping gear becomes less expensive than it is now	1	2	3	4	5	6	7
Fuel becomes more expensive than it is now	1	2	3	4	5	6	7
Fuel becomes less expensive than it is now	1	2	3	4	5	6	7
The price of a resident trapping license becomes more expensive	1	2	3	4	5	6	7
The price of a resident trapping license becomes less expensive	1	2	3	4	5	6	7
Snow depth of 0 to 6 inches	1	2	3	4	5	6	7
Snow depth of 6 to 12 inches	1	2	3	4	5	6	7
Snow depth of 12 to 18 inches	1	2	3	4	5	6	7

Temperatures ranging from -40° to -20° Fahrenheit	1	2	3	4	5	6	7
Temperatures ranging from -20° to 0° Fahrenheit	1	2	3	4	5	6	7
Temperatures ranging from 0° to 20° Fahrenheit	1	2	3	4	5	6	7
Early season melting and freezing cycles	1	2	3	4	5	6	7
Furbearer populations that are higher than current populations	1	2	3	4	5	6	7
Furbearer populations that are lower than current populations	1	2	3	4	5	6	7
Catching non-target animals	1	2	3	4	5	6	7
If other trappers are present in the area I trap	1	2	3	4	5	6	7
Pets getting caught in traps	1	2	3	4	5	6	7
Reasons for changing trapping effort	Significantly Decrease	Moderately Decrease	Slightly Decrease	Neither	Slightly Increase	Moderately Increase	Significantly Increase
If there are recreationalists in the area I trap	1	2	3	4	5	6	7
Poor health	1	2	3	4	5	6	7
Family commitments	1	2	3	4	5	6	7
Having free time	1	2	3	4	5	6	7
Difficult fur handling (skinning, fleshing, stretching)	1	2	3	4	5	6	7
Easy fur handling (skinning, fleshing, stretching)	1	2	3	4	5	6	7

Animals that are difficult to catch	1	2	3	4	5	6	7
Animals that are easy catch	1	2	3	4	5	6	7
Having to perform trail maintenance	1	2	3	4	5	6	7

IV. GENERAL INFORMATION

Directions: Put a check mark next to your answer, and fill out short answers where appropriate.

1. Did you trap during the 2013/2014 trapping season? (Choose one)

___Yes ___No

2. If you did not trap, why not? (Please specify in the space provided)

_____.
_____.
_____.

3. How did you first get into trapping? (Choose one)

___Family Member ___Learned on your own
___Friends ___Other (Please specify) _____.

4. How many years have you been trapping? (Fill in the blank)

_____Years

5. About how many months each season do you typically trap? (Fill in the blank)

_____Months

6. Which of the following game management units do you trap in the most? (Choose one)

___12 ___20 ___24 ___Other
___19 ___21 ___25

7. What is the main mode of transportation you use to run your main trapline? (Choose one)

___Airplane ___Snow Machine ___Boat ___Snowshoe/Ski
___3 or 4 Wheeler ___Passenger Vehicle ___Dog Team ___Walking

8. What is the population of the city/town/village you live in? (Choose one)

____1-100 ____501-1000 ____5001 or more
____101-500 ____1001-5000

9. How many different traplines do you have? (Fill in the blank)
_____Traplines

10. How many miles do you travel from home to get to your main trapline? (Fill in the blank)
_____Miles

11. How many miles long is/are your trapline(s)? (Fill in the blank)
Main trapline_____Miles Third trapline_____Miles Other lines_____Miles
Second trapline_____Miles Fourth trapline_____Miles _____Miles

12. Do you access your trapline from the road system? (Choose one)
____Yes ____No

13. How often do you typically check your traps? (Fill in the blanks)
_____Times per _____(Day, Week, Month, or Season)

14. Money earned from trapping is _____ of my yearly income. (Choose one)
____20% or less
____21-50%
____51-100%

15. Are you a member of any trapping organizations? (Choose one)
____Yes ____No

16. How old are you? (Fill in the blank)
____Age

17. Which race best describes you? (Choose one)
____African American ____Asian
____Alaska Native ____Native Hawaiian/Other Pacific Islander
____White /Caucasian _____Other (Please fill in the blank)

18. Are you of Spanish/Hispanic/Latino decent? (Choose one) ____Yes ____No

V. TRAPPING EFFORT

Directions: Please fill out the total number of each animal caught, the total number of individual traps and snares you set, the number of incidental catches, the number of traps set for each species, the number of snares set for each species, and the number of weeks you trapped for each species during the 2013 – 2014 trapping season. An incidental catch is trapping an animal that you were not trying to catch. *Example*: If you caught a coyote in a snare that was set for a lynx, record the coyote in the incidental catch column.

Species	Number Caught	Number of Incidental Catches for Species	Number of Weeks Trapped for Species	Number of traps set for Species	Number of Snares set for Species
Beaver					
Coyote					
Arctic Fox					
Red Fox					
Lynx					
Marten					
Mink					
Ermine or Least Weasel					
Muskrat					
River Otter					
Red Squirrel					
Wolf					
Wolverine					

Total Number of Traps set for Season	Total Number of Snares Set for Season

VI. ADDITIONAL COMMENTS

Directions: Feel free to use this space to provide any other comments you may have.

Thank you for your time and effort

Please return the completed questionnaire in the envelope provided.

Alaska Trapper Questionnaire

1945

Mail to : ADF&G, Information Service
333 Rasberry Road
Anchorage, AK 99518-1599

1. How many years total have you trapped? ☐☐
2. How many years have you trapped in Alaska? ☐☐
3. What is your date of birth? ☐☐ ☐☐ ☐☐☐☐

5. If you did not trap this year, please indicate when you last trapped.
   I last trapped: ☐ Last Year ☐ Two years ago ☐ More than two years ago
6. If you did not trap, please indicate your status:
   ☐ I intend to trap again, please send me questionnaires and the trapper report.
   ☐ Please do not send me future Trapper Questionnaires.

4. Did you trap this season?
   ☐ Yes If yes, continue the survey from question 8.
   ☐ No If no, please answer question 5-7 to the right

7. If you did not trap this season, please indicate all reasons why.
   ☐ Personal ☐ Low fur prices ☐ Other: _____
   ☐ High fuel costs ☐ Too few animals ☐ Weather conditions

8. Did you trap with a partner? ☐ Yes ☐ No
   If you trapped with a partner, to avoid duplicate responses we request that only one of you complete a Trapper Questionnaire.

9. If you answered YES on question 8, please describe your trapping partner(s).

	Age	Total years trapping?	Total years trapping in Alaska?	Relationship Code
1.	☐☐	☐☐	☐☐	☐
2.	☐☐	☐☐	☐☐	☐
3.	☐☐	☐☐	☐☐	☐
4.	☐☐	☐☐	☐☐	☐

Relationship Codes
1 = Older generation family member
2 = Same generation family member
3 = Younger generation family member
4 = Friend
5 = Other

10. Did you ever take anyone under age 16 trapping with you this year?
    ☐ Yes ☐ No

What kind of transportation did you use:

11. to travel from your home to your main trapline? (check only one)

☐ Airplane ☐ ATV, 4-wheeler, etc ☐ Highway vehicle
☐ Dog team ☐ Snowmachine ☐ Walk/ski/snowshoe
☐ Boat

12. to run your main trapline most of the time? (check only one)

☐ Airplane ☐ ATV, 4-wheeler, etc ☐ Highway vehicle
☐ Dog team ☐ Snowmachine ☐ Walk/ski/snowshoe
☐ Boat

13. How many years have you trapped the same area? ☐☐

14. How many weeks did you trap this year? ☐☐

15. On average, how many days per week did you check your traps? ☐

16. Please rate the conditions on your trapline?

☐ good ☐ fair ☐ poor

17. Did you sell or keep most furs?

☐ Sold most furs to fur buyer in Alaska
☐ Sold most furs to fur buyer outside Alaska
☐ Kept most furs
☐ Other

18. Did you change your effort from the last seaon you trapped?

☐ increased ☐ decreased ☐ no change

19. If you increased your effort, did the increase result in a higher catch?

☐ Yes ☐ No

20. If you changed your effort did you (mark all that apply):

☐ Changed to a different species ☐ Increased the length of your trapline ☐ Increased the number of sets ☐ Increased the number of weeks
☐ Trapped in a new area ☐ Decreased the length of your trapline ☐ Decreased the number of sets ☐ Decreased the number of weeks

21. Please desribe your trapline(s). Game Management Units (GMUs) are indicated by numbers from 1-26; larger GMUs are divided into subunits that are indicated by letters. Use the map to determine the GMU/Subunit.

	Length (miles)	Number of sets	GMU/ subunits	Drainages
Example	56	134	20A	Tanana River
Main				
2nd				
3rd				
4th				

22. Please write the *number* of furbearers you took on your traplines.

	Main	2nd	3rd	4th
Arctic Fox				
Beaver				
Coyote				
Ermine				
Lynx				
Marten				
Mink				
Muskrat				
Red Fox				
Red Squirrel				
River Otter				
Wolf				
Wolverine				

23. Please write the *number* of pelts you took with each method.

Shot	Snared	Leg Hold	Conibear	Other

24. Did any of the following factors affect your trapping effort this season? Please mark all that apply and indicate if they caused you to increase or decrease your effort compared to last season.

	Increase	Decrease		Increase	Decrease
Trapping conditions	☐	☐	Other trappers	☐	☐
Previous season prices	☐	☐	Fuel prices	☐	☐
Pre-season advertised prices	☐	☐	Regulation changes in your area	☐	☐

25. Species	During the previous season was each species on your main trapline:				Please compare the number of animals you saw this year to last year.			Did you target this species?		Please rank the top 3 species you targeted.		
	Not present	Scarce	Common	Abundant	Fewer	Same	More	Yes	No	1	2	3
Example												
Lynx	☐	☒	☐	☐	☒	☐	☐	☒	☐	☐	☒	☐
Marten	☐	☐	☒	☐	☐	☐	☒	☒	☐	☒	☐	☐
Arctic Fox	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Beaver	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coyote	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ermine	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Lynx	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Marten	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mink	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Muskrat	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red Fox	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Red Squirrel	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
River Otter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wolf	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Wolverine	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Grouse	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hare (Rabbit)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mice/Rodents	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ptarmigan	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

26. We are looking for ways to improve the Trapper Questionnaire. Please suggest changes, especially ideas for types of information that would make the annual Trapper Questionnaire Report more useful for trappers.

27. Do you have any other comments or suggestions for ADF&G or the Board of Game regarding how trapping can be improved in Alaska?

28. The Department is building a collection of trapping-related photos for use in reports, publications, and presentations. We are interested in photos showing all aspects of trapping from setting traps to checking traps to processing animals to fleshing and stretching hides. If you would like to share any of your trapping photos with the Department, please e-mail your pictures to me at **dfg.dwc.permits@alaska.gov**. In your e-mail please include some information about each photo like where it was taken, what it shows, and names of any people. Please also tell us if you would like us to use your photo(s) only in Trapper Questionnaire Reports or if we may use the photo in other ADF&G publications and presentations. Photos should be no less than 1 megabyte file size and can be as large as 20 mb.

Thanks for participating in the Trapper Questionnaire Program. I greatly appreciate the time and effort you put into completing this survey. You are our best source of information on factors that affect trappers and furbearer harvest, and you are our only source of harvest information for furbearers that are not sealed. Your response will help us determine the status and value of each species. As always, your identity will be kept strictly confidential, and this information is not used for any purpose other than producing the Trapper Report. Thanks again for your help!

Sincerely,
Tom Schumacher
Trapper Questionnaire Coordinator

Appendix C: Interview questionnaire script

Interview questions script

- Hello, my name is Ross Dorendorf. I am a master's student at the University of Alaska – Fairbank. I am conducting interviews for my master's project with trappers from Interior Alaska. I recently sent out a questionnaire to a randomly selected group of trappers in which you were included. I did not hear back from you, and wish to ask a few questions about why you trap. Your response is very important.
- All the information I collect will remain anonymous.
- Data collected from this interview will help assess if people who did not respond to the questionnaire are different than those who did.
- Are you over 18 years old?
- The interview may take about 20 minutes.
- Your participation is voluntary, and you don't have to participate if you don't want to. We can stop the interview at any time.
- If you have any questions or concerns about your rights as a participant contact the UAF Office of Research Integrity at 907-474-7800 (Fairbanks area) or 1-866-876-7800 (toll-free outside the Fairbanks area) or uaf-irb@alaska.edu.
- Would you like to participate in this study?

1. Have you trapped in past years?
    a. If no, why not?
2. Are you currently trapping in the 2013/2014 trapping season?
    a. If no, why not?
3. For what reasons did you trap this year?
    a. Which of these reasons are the most important in deciding to trap or not?
4. What are some current issues that are important to trapping? In general, any issues you think are important
    a. Why is this important?
    b. Which of those reasons is the most important?
    c. Probes
        i. Trapper recruitment

ii. Trapper image

iii. Trapper on trapper conflicts

iv. Trapper vs. recreationalist conflicts

v. Pets getting caught in traps

vi. Trapping regulations

5. Are there any reasons you would not trap for a season?
    a. What are they, and why?
    b. Which of these reasons is the most important?
6. What determines how much effort you put into trapping? In terms of how much time you put into trapping, how many traps you set, how many times you check traps, and how long your trapline is.
    a. Why?
    b. Probes:
        i. Price of pelts
        ii. Abundance of furbearers
        iii. Weather conditions
        iv. Price of gas
        v. Personal reasons
        vi. Conflict with other trappers, pet owners, recreationalists
        vii. Regulations
        viii. Ease of trapping an animal
        ix. Ease of fur preparation

Do you know of other trappers that may like to participate in this study?

Appendix D: Institutional review board approval letter 1

UNIVERSITY OF ALASKA FAIRBANKS

(907) 474-7800
(907) 474-5444 fax
uaf-irb@alaska.edu
www.uaf.edu/irb

Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

January 31, 2014

To:	Laura Prugh, PhD Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[536124-1] Motivations and drivers of trapping catch per unit effort in Interior Alaska

Thank you for submitting the New Project referenced below. The submission was handled by Exempt Review. The Office of Research Integrity has determined that the proposed research qualifies for exemption from the requirements of 45 CFR 46. This exemption does not waive the researchers' responsibility to adhere to basic ethical principles for the responsible conduct of research and discipline specific professional standards.

Title:	Motivations and drivers of trapping catch per unit effort in Interior Alaska
Received:	January 23, 2014
Exemption Category:	2
Effective Date:	January 31, 2014

This action is included on the February 5, 2014 IRB Agenda.

Prior to making substantive changes to the scope of research, research tools, or personnel involved on the project, please contact the Office of Research Integrity to determine whether or not additional review is required. Additional review is not required for small editorial changes to improve the clarity or readability of the research tools or other documents.

Appendix E: Institutional review board approval letter 2

UNIVERSITY OF ALASKA FAIRBANKS

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Institutional Review Board

909 N Koyukuk Dr. Suite 212, P.O. Box 757270, Fairbanks, Alaska 99775-7270

March 11, 2014

To:	Laura Prugh, PhD Principal Investigator
From:	University of Alaska Fairbanks IRB
Re:	[536124-2] Motivations and drivers of trapping catch per unit effort in Interior Alaska

Thank you for submitting the Amendment/Modification referenced below. The submission was handled by Exempt Review. The Office of Research Integrity has determined that the proposed research qualifies for exemption from the requirements of 45 CFR 46. This exemption does not waive the researchers' responsibility to adhere to basic ethical principles for the responsible conduct of research and discipline specific professional standards.

Title:	Motivations and drivers of trapping catch per unit effort in Interior Alaska
Received:	March 9, 2014
Exemption Category:	*2*
Effective Date:	March 11, 2014

This action is included on the April 2, 2014 IRB Agenda.

Prior to making substantive changes to the scope of research, research tools, or personnel involved on the project, please contact the Office of Research Integrity to determine whether or not additional review is required. Additional review is not required for small editorial changes to improve the clarity or readability of the research tools or other documents.

Appendix F: Initial contact post card

Dear Trapper,

My name is Ross Dorendorf. I am a master's student at the University of Alaska – Fairbanks. My research is focused on Interior Alaskan trappers. I will be sending out an important questionnaire to you soon. The purpose is to find out what motivates trappers to trap. With this questionnaire I want to explore obstacles to being an active trapper. Once these obstacles are known, managers may be able to reduce them for trappers.

The results of this study are to benefit trappers. I have trapped since I was 16 years old, and I want trapping to be enjoyed by future generations of Alaskans. Trapping is very important to me.

Sincerely,

Ross Dorendorf
Masters Student
University of Alaska – Fairbanks
Department of Biology and Wildlife
PO BOX 756100
Fairbanks, AK 99775 - 6100

Appendix G: Initial cover letter

College of Natural Science and Mathematics
Department of Biology and Wildlife
PO BOX 756100
Fairbanks, AK 99775 - 6100
651 – 491 - 1665

You have been chosen to take part in a study about the motivations of trappers. You were chosen for this study among 2012 trapping license holders who live in game management units 12, 19-21, 24 and 25.

We need your help to learn what changes trapping effort. Wildlife managers do not know much about what motivates the trappers of Alaska. Not much is known about why trapping effort changes either. The amount of effort you put into trapping can change with current issues. This survey can give managers a better idea of why someone traps. It can also be used to explain why fur harvests change. Your input is very valuable and it is important that we get your feedback.

This survey will take about 20 minutes to finish. Please return it in the prepaid envelope provided. This survey is voluntary with no risks related to your participation. Replies will remain confidential. The number on the survey is so we can check your name off of the mailing list when we get your response. You must be at least 18 years old to participate. By returning this survey you are agreeing to participate in this study. If you have any questions or comments, you can reach us by the phone or e-mail below. If you have any questions about your rights as a participant, please contact UAF Office of Research Integrity at 907-474-7800 or toll free at 1-866-876-7800 or uaf-irb@alaska.edu.

By mailing back a completed survey you will be entered into a drawing. Five winners will get a $50 gas gift card. You may only win if you mail back a fully completed survey.

I have trapped since I was 16 years old. I am happy to have the chance to give back to trappers.

Thank you for your help,

Sincerely,

Ross Dorendorf
Master Candidate
Department of Biology and Wildlife
University of Alaska – Fairbanks
(907) 474 - 7456
rrdorendorf@alaska.edu

Laura Prugh, Ph D.
Principal Investigator
Associate Professor
Department of Biology and Wildlife
University of Alaska – Fairbanks
(907) 474 - 5965
Lprugh@alaska.edu

Appendix H: Reminder post card

This is a reminder to please fill out and mail back the survey sent to you several weeks ago. Even if you only trap a little or have not trapped for many years, your response is very important. If you have already mailed back the survey, thank you very much for your help.

This study aims to benefit trappers. This information can help managers better understand what motivates people to change their trapping effort. Managers may be able to use this study to improve management in Alaska.

Please contact me if you do not have a survey, or need a replacement at (907) 474 - 7456, or rrdorendorf@alaska.edu. Your effort is greatly appreciated. Thank you for the help!

Sincerely,

Ross Dorendorf
Masters Student
University of Alaska – Fairbanks
Department of Biology and Wildlife
PO BOX 756100
Fairbanks, AK 99775 - 6100

Appendix I: Reminder cover letter

College of Natural Science and Mathematics
Department of Biology and Wildlife
PO BOX 756100
Fairbanks, AK 99775 - 6100
907-474-7456

We are writing you again to express our need for your response. So far we have not received a response from you. If you have finished the survey in the past few days and sent it back, thank you for your time and effort. Even if it has been a very long time since you trapped, or you do not trap very much, your response is very important to us.

You are one of the few chosen for this study among 2012 trapping license holders who live in game management units 12, 19-21, 24 and 25.

We need your help to learn what changes trapping effort. Not much is known about why trapping effort changes, and what motivates trapper to trap. I believe this survey can give managers a better idea of why people trap. It can also be used to explain why fur harvests change. Your response is crucial to understand these things.

We assure you this survey is voluntary with no risks related to your participation. Replies will remain **confidential**. The number on the survey is so we can check your name off of the mailing list when we get your response. We have enclosed another survey in case the first one you got has been misplaced.

You must be at least 18 years old to participate. By returning this survey you are agreeing to participate in this study. If you have any questions or comments, you can reach us by the phone or e-mail below. If you have any questions about your rights as a participant, please contact UAF Office of Research Integrity at 907-474-7800 or toll free at 1-866-876-7800 or uaf-irb@alaska.edu.

By mailing back a completed survey you will be entered into a drawing. Five winners will get a $50 gas gift card. You may only win if you mail back a fully completed survey.

I have trapped since I was 16 years old. I am happy to have the chance to work with such a great group of people.

Thank you for filling out and sending back a completed survey, your input is very important.

Sincerely,

Ross Dorendorf
Master Candidate
Department of Biology and Wildlife
University of Alaska – Fairbanks
(907) 474 - 7456
rrdorendorf@alaska.edu

Laura Prugh, Ph D.
Principal Investigator
Associate Professor
Department of Biology and Wildlife
University of Alaska – Fairbanks
(907) 474 – 5965
Lprugh@alaska.edu

Appendix J: Non-response interview questions script

Non-response interview questions script

- Hello, my name is Ross Dorendorf. I am a master's student at the University of Alaska – Fairbank. I am conducting interviews for my master's project with trappers from Interior Alaska. I recently sent out a questionnaire to a randomly selected group of trappers in which you were included. I did not hear back from you, and wish to ask a few questions about why you trap. Your response is very important.
- All the information I collect will remain anonymous.
- Data collected from this interview will help assess if people who did not respond to the questionnaire are different than those who did.
- Are you over 18 years old?
- The interview may take about 20 minutes.
- Your participation is voluntary, and you don't have to participate if you don't want to. We can stop the interview at any time.
- If you have any questions or concerns about your rights as a participant contact the UAF Office of Research Integrity at 907-474-7800 (Fairbanks area) or 1-866-876-7800 (toll-free outside the Fairbanks area) or uaf-irb@alaska.edu.
- Would you like to participate in this study?

1. Have you trapped in past years?
    a. If no, why not?
2. Did you trap in the 2013/2014 trapping season?
    a. If no, why not?
3. For what reasons did you trap this year?
    a. Which of these reasons are the most important in deciding to trap or not?
4. What are some current issues that are important to trapping? In general, any issues you think are important
    a. Why is this important?
    b. Which of those reasons is the most important?
    c. Probes
        i. Trapper recruitment

ii. Trapper image

iii. Trapper on trapper conflicts

iv. Trapper vs. recreationalist conflicts

v. Pets getting caught in traps

vi. Trapping regulations

5. Are there any reasons you would not trap for a season?
    a. What are they, and why?
    b. Which of these reasons is the most important?
6. What determines how much effort you put into trapping? In terms of how much time you put into trapping, how many traps you set, how many times you check traps, and how long your trapline is.
    a. Why?
    b. Probes:
        i. Price of pelts
        ii. Abundance of furbearers
        iii. Weather conditions
        iv. Price of gas
        v. Personal reasons
        vi. Conflict with other trappers, pet owners, recreationalists
        vii. Regulations
        viii. Ease of trapping an animal
        ix. Ease of fur preparation

Appendix K: Cronbach's alpha reliability of external factors

Cronbach's alpha reliability analysis of external factors

External factor	n	Percent of respondents			Cronbach's alpha (α)
		Decrease	Increase	Neither	
Economics					0.706
Fur prices that are higher than current prices	338	4.4	59.5	36.1	
Fur prices that are lower than current prices	339	31.3	8.6	59.9	
Trapping gear becomes more expensive than it is now	336	29.8	20.5	49.7	
Trapping gear becomes less expensive than it is now	337	9.5	35	55.5	
Fuel becomes more expensive than it is now	337	44.2	27.6	28.2	
Fuel becomes less expensive than it is now	334	12	50.9	37.1	
More expensive resident trapping license	334	18	11.4	70.7	
Less expensive resident trapping license	333	7.2	16.5	76.3	
Weather					0.576
Snow depth of 0 to 6 inches	332	39.5	20.5	40.1	
Snow depth of 12 to 18 inches	337	13.1	40.1	46.9	
Temperatures ranging from -40° to -20° F	336	45.8	16.4	37.8	
Temperatures ranging from 0° to 20° F	334	11.7	44	44.3	
Early season melting and freezing cycles	335	43.6	17.3	39.1	
Abundance					0.458
Furbearer populations that are higher than current populations	337	7.7	67.7	24.6	
Furbearer populations that are lower than current populations	335	60.6	9.9	29.6	
Catching non-target animals	337	39.8	6.2	54	
Personal					0.694
Poor health	333	64.9	7.2	27.9	
Family commitments	335	54.6	12.5	32.8	
Having free time	335	23.6	46.9	29.6	
Trapping Work					0.638
Difficult fur handling (skinning, fleshing, stretching)	333	19.8	6	74.2	

Appendix K continued...

External factor	n	Percent of respondents			Cronbach's alpha (α)
		Decrease	Increase	Neither	
Trapping Work					
Easy fur handling (skinning, fleshing, stretching)	336	6	27.1	67	
Animals that are difficult to catch	335	11.3	27.8	60.9	
Animals that are easy to catch	336	8.9	28.3	62.8	
Having to perform trail maintenance	335	14.6	22.1	63.3	

Note. Percentage of respondents that said their trapping effort increases, decreases, or neither under the conditions stated. Cronbach's alpha was conducted on the item scales. Results are based on external factors that influence trapping effort of the trappers in interior Alaska, USA in 2013.

Appendix L: Cronbach's alpha reliability analysis of social issues

Cronbach's alpha reliability analysis of social issues

Social issue	n	Percent of respondents			Cronbach's alpha (α)
		Disagree	Agree	Neither	
Trapper recruitment					0.075
There are enough new trappers to replace old trappers	330	46.4	40.6	13	
Not enough trappers are teaching new people how to trap	330	20.9	60.3	18.8	
Trapper Image					0.770
The public sees trapping as humane	329	62.9	19.1	17.9	
The public has an overall positive image of trapping	331	65	22.7	12.4	
Trapper vs. trapper conflict					0.760
There are more trappers in Alaska now than there used to be	331	49.5	26.6	23.9	
Conflicts between trappers prevent people from trapping	329	32.5	46.5	21	
Conflicts between trappers are happening more than they used to	330	26.1	40.9	33	
Conflicts between trappers have led people to change their trapline	330	15.8	63.6	20.6	
It is difficult to find a place to trap	331	21.8	63.4	14.8	
The most frequent conflicts trappers have are with other trappers	329	26.1	43.2	30.7	
Trapper vs. public conflict					0.809
The number of pets caught in traps is increasing in recent years	328	37.2	27.4	35.4	
The number of incidents of people disturbing traps has been increasing	330	17.6	52.7	29.7	
Recreational users limit where people can trap	327	18.7	64.2	17.1	
The most frequent conflicts trappers have are with recreationalists	329	21.3	54.4	24.3	
Furbearers being stolen out of traps has been increasing in recent years	330	18.8	33	48.2	
The number of traps being stolen has been increasing in recent years	329	16.7	41.9	41.3	
Regulations					0.760
Trapping seasons need to be longer than they currently are	328	42.4	25.9	31.7	
Trapping seasons need to be shorter than they currently are	330	55.8	6.7	37.6	

Appendix L continued...

Social issue	n	Percent of respondents			Cronbach's alpha (α)
		Disagree	Agree	Neither	
Regulations					
Current trapping regulations are too strict	330	44.5	20	35.5	
Access					0.914
More federal land needs to be opened up to trapping	333	10.2	71.2	18.6	
More state land needs to be opened up to trapping	330	10.3	63.9	25.8	

Note. Percentage of respondents that agreed, disagreed or neither that the following social issues in trapping were of concern to them. Cronbach's alpha was conducted on the item scales. Cronbach's alpha was not calculated for cells containing (-). Results are based on social issues of concern to trappers of interior Alaska, USA in 2013.

Appendix M: Alaska Department of Fish and Game data-share agreement 1

AGREEMENT FOR USE OF WILDLIFE DATA

BETWEEN

THE ALASKA DEPARTMENT OF FISH & GAME

AND

DEPARTMENT OF BIOLOGY AND WILDLIFE, UNIVERSITY OF ALASKA, FAIRBANKS

This agreement covers the following file transferred to Ross Dorendorf: trapper survey questionnaire data for Region III for the regulatory years 1989 through 2013.

This information is released to, and may be used by Ross Dorendorf only under the following conditions:

1. The information will be used to evaluate factors affecting catch per unit effort for furbearers. Other uses of the data are prohibited without subsequent agreement by both parties
2. The information will not be released to others. Personal data shall not be publically disseminated.
3. Personal data (such as unique_identifier and q3 (date of birth)) shall not be publically disseminated in any way.
4. Data, including personal data, will not be published or publically disseminated by any means or in any form that would allow connection between an individual and his or her harvest or that would allow judgments to be made about a person's character, habits, avocations, finances, general reputation, or other personal characteristics.
5. Data from communities (trapper_city) with only one or two respondents shall be pooled with appropriate adjacent communities to protect personal information.
6. All data, analyses and conclusions will be presented at no finer scale than game management subunit. It shall not be presented at the minor UCU coding level.

Under the above conditions, ADF&G agrees to release the attached information, and Ross Dorendorf agrees to receive and use it.

STATE OF ALASKA
DEPARTMENT OF FISH & GAME
DIVISION OF WILDLIFE CONSERVATION

for Doug Vincent-Lang, Deputy Div — Date 9/21/14

By _____ — Date 8-6-14
Ross, Dorendorf, graduate student, UAF

By _____ — Date 8/19/14
Dr. Laura Prugh, academic advisor, UAF

Appendix N: Alaska Department of Fish and Game data-share agreement 2

AGREEMENT FOR USE OF WILDLIFE DATA BETWEEN

THE ALASKA DEPARTMENT OF FISH & GAME

AND

DEPARTMENT OF BIOLOGY AND WILDLIFE, UNIVERSITY OF ALASKA, FAIRBANKS

This agreement applies to the following data provided to Ross Dorendorf: selected annual Trapper Questionnaire data for the state of Alaska for the regulatory years 1989 through 2013.

These data are released to, and may be used by Ross Dorendorf only under the following conditions:

1. The data shall be used to evaluate factors affecting catch per unit effort for furbearers harvested under a trapping license. Other uses of the data are prohibited without subsequent agreement.
2. The data shall not be released to others except in summary form in reports, theses, or publications.
3. The data shall not be published or publically disseminated by any means or in any form that would allow connection between an individual and his or her harvest or that would allow judgments to be made about a person's character, habits, avocations, finances, general reputation, or other personal characteristics. This specifically includes the following:
    a. Personal data (such as unique_identifier and q3 (date of birth)) shall not be publically disseminated in any way.
    b. Data from communities (trapper_city) with fewer than three respondents shall be pooled with appropriate adjacent communities to protect personal data.
4. All data, analyses and conclusions shall be presented at no finer scale than game management subunit. Data shall not be presented at the minor UCU coding level.
5. Reports, theses, and publications based on these data shall be submitted electronically to the ADF&G, Division of Wildlife Conservation, Permits Section at dfg.dwc.permits@alaska.gov.

Under the above conditions, ADF&G agrees to release the attached data, and Ross Dorendorf agrees to receive and use it as described above.

STATE OF ALASKA
DEPARTMENT OF FISH & GAME
DIVISION OF WILDLIFE CONSERVATION

By _____ Date 1/2/15
Maria Gladziszewski, Assistant Director

By _____ Date 1-2-15
Ross, Dorendorf, graduate student, UAF

By _____ Date 1/5/15
Dr. Laura Prugh, academic advisor, UAF

Appendix O. Locations of land-based weather stations

Locations (decimal degrees) and elevations of National Oceanic and Atmospheric Administration's (NOAA) land based weather stations in Alaska, USA. Stations are separated by Alaska Department of Fish and Game (ADF&G), game management region 1-5 (ADF&G 2014).

Region	Station name	Elevation (m)	Latitude	Longitude
1	Pelican	3.7	57.95770	-136.22130
1	Point Baker	6.1	56.35110	-133.62630
1	Annette Weather Service Office Airport	33.2	55.03890	-131.57870
1	Yakutat Airport	10.1	59.51200	-139.67120
1	Juneau Outter Point	13.7	58.29440	-134.67530
2	Kenai Lake	144.8	60.36670	-149.40000
2	Kodiak Airport	24.4	57.75111	-152.48556
2	Cordova MK Smith Airport	9.4	60.48880	-145.45110
3	Bettles Airport	195.7	66.91611	-151.50889
3	Chulitna River	411.5	62.82917	-149.89611
3	Fairbanks International Airport	131.7	64.80389	-147.87611
3	Chandalar Shelf Airport	990.6	68.07806	-149.56472
4	Cold Bay Airport	23.8	55.22083	-162.73250
4	May Creek	487.7	61.32080	-142.58440
4	Dutch Harbor	3.0	53.89500	-166.54330
4	Chistochina	701.0	62.56530	-144.66470
5	Reindeer River	42.7	61.71610	-162.66500
5	Kivalina Airport	3.0	67.73167	-164.54833
5	Bethel Airport	31.1	60.78500	-161.82930
5	Noatak	300.2	68.07080	-158.70420

Appendix O continued...

Region	Station name	Elevation (m)	Latitude	Longitude
5	Wainwright Airport	9.1	70.63917	-159.99500
5	Quartz Creek	130.1	65.40000	-164.65000
5	Haycock	53.9	65.20170	-161.15500
5	Barrow 4 ENE	4.6	71.32130	-156.61100